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# Federative Republic of Brazil

## National Road Safety Capacity Review

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# CONTENTS

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Glossary.....	3
Acknowledgements.....	5
Endorsement.....	6
Executive summary .....	7
<b>1 INTRODUCTION.....</b>	<b>13</b>
1.1 Brazil’s Transport Context.....	13
1.2 The Global Road Safety Situation.....	13
1.3 The United Nations Decade of Action for Road Safety 2011-2020 and Future Plans.....	14
1.4 The Safe System Approach .....	15
1.5 World Bank and Other Partners for Road Safety in Brazil .....	15
<b>2 REVIEW DESCRIPTION .....</b>	<b>17</b>
2.1 Approach to the Review.....	17
2.2 Aims of the Review .....	17
2.3 Scope.....	18
2.4 Review Methodology .....	18
<b>3 ROAD SAFETY SITUATION IN BRAZIL.....</b>	<b>19</b>
3.1 Background and National Situation .....	19
3.2 Institutional Context .....	19
3.3 Road Safety Outcomes in Brazil .....	21
3.4 Estimating the Cost of Crashes in Brazil.....	26
3.5 Crime versus Road Crashes in Brazil .....	27
3.6 Summary of Key Fatal and Injury Crash Factors in Brazil.....	27
<b>4 FINDINGS OF THE MANAGEMENT CAPACITY REVIEW.....</b>	<b>30</b>
4.1 Lead Agency Role and Institutional Management Functions .....	30
4.2 Results Focus at the System Level .....	33
4.3 Coordination .....	36
The need for multi-sectoral and across State Government Agency Coordination and Collaboration .....	36
4.4 Legislation .....	39
4.5 Funding and Resource Allocation .....	41
4.6 Promotion and Education .....	43
4.7 Monitoring and Evaluation .....	46
4.8 Research and Development and Knowledge Transfer.....	47
4.9 Capacity to Deliver Results over the Elements of the System to be Managed.....	48

5	Recommendations .....	54
5.1	Area of Opportunity 1: Institutional Leadership, Management Capacity, Co-ordination and Culture change .....	54
5.2	Area of Opportunity 2: Crash Data Systems Development .....	57
5.3	Area of Opportunity 3: Funding and resource allocation. ....	58
5.4	Area of Opportunity 4: Results focus, monitoring and evaluation. ....	59
5.5	Area of Opportunity 5: Research, development and knowledge transfer. ....	60
5.6	Area of Opportunity 6: Multi-sectoral promotion, advocacy, and education for Road Safety .....	61
5.7	Area of Opportunity 7: Road Safety delivery by States and Municipalities.....	63
5.8	Area of Opportunity 8: Management of the Road Network.....	64
5.9	Area of Opportunity 9: Management of Road User Behavior .....	69
5.10	Area of Opportunity 10: Management of Travel Speeds.....	74
5.11	Area of Opportunity 11: Management of Motorcycle Safety.....	77
5.12	Area of Opportunity 12: Management of Vehicles.....	80
5.13	Area of Opportunity 13: Recovery and Rehabilitation of Crash Victims.....	81
5.14	Area of Opportunity 14: Reduced Road Use.....	81
	ANNEX 1 – World Bank Guidelines for Capacity Review .....	83
	ANNEX 2 – List of People and Organizations Consulted .....	85
	ANNEX 3 – The Safe Systems Approach.....	90
	ANNEX 4 – Examples of Valuable Road Safety Initiatives and Programs in Brazil.....	92
	ANNEX 5 – Detailed Findings: Capacity for Results.....	103
	ANNEX 6 – Proposed Structure for the National Lead Agency .....	137
	ANNEX 7 – Detailed Analysis and Proposals on Legal and Regulatory Framework for Road Safety ..	140

# GLOSSARY

US\$ 1.00 = BRL 3.80

BRL 1.00 = US\$ 0.26

ABRAMET - Brazilian Association of Traffic Medicine

ABRASPE - Brazilian Association of Pedestrians

Ande Bem - Traffic Psychology Institute

ANFAVEA - National Association of Automotive Vehicle Manufacturers

ANTP - National Association of Public Transportation

ANTAQ - National Agency for Waterway Transportation

ASIRT - Association for Safe International Road Travel

ATLAS BRASIL - Atlas Transportation & Logistics Ltd.

BAC - Blood Alcohol Concentration

BM - Military Brigade-State Highway Police

Civil Police → Police who normally manage crime, but are also involved in the reporting of crashes, and to whom citizens can report crashes, and who are involved in the processes of prosecution of drivers after crashes.

CONTRAN - Federal Transport Committee

CRIANÇA SEGURA - Safe Kids Brazil

CTB – Brazilian Traffic Code

DataSUS - The national database, Ministry of Health Mortality Information System, based on information from Hospitals and Death Certificates.

DENATRAN - Federal Traffic Department

DER or DAER - State Highway Departments

DETRAN - State Department of Traffic

DPVAT – Insurance Company for Personal Injury Caused by Motor Vehicles

EMBARQ - the World Resources Institute center for Sustainable Transport

EPTC - Public Transportation and Circulation Company - Porto Alegre

FIA - Fédération Internationale de l'Automobile

GDP - Gross Domestic Product

GRSF - Global Road Safety Facility

GRSP - Global Road Safety Partnership

ICD-10 - International Classification of Diseases, 10th version

ICT - Information & Communication Technologies (World Bank)

IGP - General Institute Forensic (Accident Evaluation)

IML - Forensic Medical Institute, which issues Death Certificates

IPEA - Applied Economics Research Institute

iRAP - International Road Assessment Program

IRTAD - International Traffic Safety Data and Analysis Group

Lastran - Transportation Systems Laboratory/Federal University of RS

NCAP - New Car Assessment Program

OLN – National Leadership Organism  
ONSV - National Observatory for Road Safety  
OECD - Organization for Economic Co-operation and Development  
PAHO - Pan-American Health Organization  
PRF - Federal Highway Police  
PVNT - Life in Traffic Project.  
RS10 - Road Safety in 10 Countries (funded by Bloomberg Family Foundation)  
Seguradora Líder – DPVAT Administrative Consortium  
SEINFRA - Infrastructure Secretariat of the State of Bahia  
SEPLAG - Secretariat of Planning and Management of the State of RS  
SETCERGS - Freight Transportation Companies Union of the State of RS  
SOMA – Observation, Monitoring and Action System  
UN - United Nations  
WHO - World Health Organization

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In undertaking this national review, the team benefited greatly from many previous visits to Brazil and three previous road safety management capacity reviews, which were carried out in the States of São Paulo, Rio Grande do Sul, and Bahia. The insights of several individuals across all levels of government, as well as non-government actors, who offered their time and expert input during all these reviews, have rounded out our understanding of road safety in Brazil and the country's management capacity for delivering road safety improvements. In each state, we received important assistance from the roads agencies (*Departamento de Estradas de Rodagens*) of São Paulo and Bahia (DER/SP and DERBA) and the *Departamento Autônomo de Estradas de Rodagem* of Rio Grande do Sul (DAER), the secretariats of planning and infrastructure, the state departments of traffic (*Departamento de Transito* DETRAN), the State Military Road Police, Federal Highway Police, municipalities, and a number of NGOs as well as other organizations, including *Líder DPVAT* Insurance (an insurance company for personal injury caused by motor vehicles) and the National Observatory for Road Safety (ONSV).

The national review included a key workshop in Brasilia in November 2014, with contributions from many federal government departments and other stakeholders, and a workshop to present the draft findings for feedback in June 2015. The World Bank team met with representatives of key federal government departments and the Federal Highway Police, members of parliament, and other key actors in Brasilia. In addition, the team was hosted and assisted by the ONSV and received input from three additional states visited in January and March 2015—Ceará, Goiás, and Tocantins—whose state government departments, State Military Road Police, or municipalities provided effective assistance and information. Many meetings spanning several hours reflected the vital interest in road safety of those involved. We are indebted to all who participated for their generosity in sharing their time, expertise and profound local knowledge.

# Endorsement

As the number of road crashes in Brazil continues to grow, road safety has become a priority for national and global action. According to the World Health Organization, 1.25 million people are killed each year on the roads, and up to 50 million are injured. Road traffic crashes are the eighth leading cause of death globally and the leading cause of death for people aged 15–29. Over 90 percent of road accident-related deaths occur in low-income and middle-income countries. Road safety in Brazil, sadly, is no exception to this global crisis.

The World Bank has engaged in ongoing cooperation with Brazil in the transport area for the past 50 years and is committed to supporting Brazil's national road safety agenda in partnership with other agencies and programs. The Global Road Safety Facility was established by the World Bank to scale up efforts to assist client countries with systematically tackling road safety. In 2008, the World Bank made road safety a pillar of its Safe, Clean and Affordable Transport for Development strategy for the transport sector. In 2011, the United Nations proclaimed a Decade of Action for Road Safety (2011-2020) in an effort to reduce global road deaths, and the World Bank has been collaborating closely with UN colleagues to achieve the Decade of Action's important objectives. The growing global momentum and strong international collaboration, together with the leadership of our partners, such as the Brazilian authorities, make us optimistic that we will succeed.

This *National Road Safety Management Capacity Review* examines road safety management in Brazil and makes recommendations to improve road safety outcomes, building on experiences in the country and international best practices. The Decade of Action is now at its mid-point, and in September 2015, the United Nations General Assembly approved two specific road safety targets as part of the Sustainable Development Goals (SDG). The second Global High-level Conference on Road Safety, held in Brasilia on November 18-19, 2015, took stock of what has been achieved so far and provide a roadmap for implementation of the road safety SDG target of halving the number of fatalities and injuries from road crashes by 2020.

It is our hope that this report will contribute to Brazil's road safety agenda, scale up the partnership with all stakeholders, NGOs, policy makers, and private sector partners, and ultimately contribute to the achievement of the road safety SDG targets.

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# Executive Summary

## *Background*

As part of a long-term partnership between the World Bank and Brazil, the Federal Government of Brazil sought the World Bank's assistance to review road safety management capacity in Brazil, building both on past experiences in the country and international best practices. This *National Road Safety Management Capacity Review*, therefore, was prepared by the World Bank, with the support of the Global Road Safety Facility (GRSF).

The primary objective of the review is to evaluate the multisectoral capacity of road safety management in Brazil, identifying possible road safety challenges and presenting recommendations to address these challenges. The methodology of the review, in accordance with the guidelines of the World Bank Global Road Safety Facility, focused on examinations of key functional aspects of road safety, including institutions, legislation, financing, information, and capacities at all levels of government and among non-government actors. The review was prepared mainly based on interviews of key road safety stakeholders at the federal, state, and municipal levels, members of parliament, NGOs, and the private sector, in addition to direct inspection of roads and on-road behaviors, and the analysis of published research and reports on road safety. In addition, information and understanding gained from previous reviews of the states of São Paulo, Rio Grande do Sul, and Bahia were also incorporated.

## *Road Safety Situation in Brazil*

**Current levels of human and economic trauma from traffic accidents are unsustainable for Brazil**, with deaths and injuries from road crashes at epidemic levels. In addition to the human suffering caused, the resulting losses from traffic accidents represent a very important challenge for the country's economy.

**It is estimated, from official 2013 statistics, that more than 42,000 people died in traffic accidents in this year.** Based on the DataSUS database, the only official database of deaths on Brazil's roads, the number of deaths and serious injuries resulting from traffic accidents has increased substantially since the beginning of 2000. Between 2001 and 2013, the number of deaths increased 37 percent, and the number of serious injuries doubled. DataSUS estimates the number of crash-related fatalities for 2012 alone at 45,751, and 42,266 for 2013. In 2012, DataSUS estimated that traffic accidents caused 190,000 serious injuries. Although there is a correlation between the increased number of deaths and injuries with a strong increase in motorization during the 2001–2013 period, this trend toward an increase of the number of deaths and injuries from traffic accidents remains serious.

**The mortality rate from traffic accidents in Brazil is worrisome.** In 2012, the death rate from traffic accidents in Brazil was estimated at 23.6 per 100,000 population (based on a population of 194 million) and at 21.6 for 2013 (based on a population of 196 million). On one

hand, the slight reduction from 2012 to 2013 is a positive development, and it is hoped that this trend will continue in the coming years. However, the mortality rate from road accidents is still higher than in other Latin America countries and a far cry from the rate in countries that demonstrate the best road safety performance in the world. In Chile and Argentina alone, death rates are almost half the rates in Brazil, with around 12 deaths per 100,000 population (2013), while the best countries posted rates between 3 and 5 deaths per 100,000 population during this period.

**In Brazil, traffic accidents kill almost as many people as crimes, including homicides; yet, the fight against crime and violence is given a much higher priority than road safety.** In official numbers for 2012, 45,751 people died from traffic accidents, in comparison to 56,337 homicides. Even worse, from 2002 to 2012, fatalities from traffic accidents in Brazil increased 37 percent, while homicides increased 13 percent in absolute terms.

**In terms of road trauma, men and young adults are over-represented among the victims.** In Brazil, overall, 81.8 percent of road deaths are of men, with the 18-24 or 30-39 age groups demonstrating the highest number of deaths in every state. Furthermore, the proportion of deaths of pedestrians and motorcyclists is increasing. Motorcycles represent 26.4 percent of the motorized fleet, but constitute 52.0 percent of motorized vehicle occupant deaths and an alarming 82.6 percent of seriously injured motorized vehicle occupants.

**Improving road safety is not merely a charitable act to alleviate human suffering; it is essential for the economy of Brazil in view of the massive economic cost of traffic accidents.** It is estimated that the economic cost of traffic accidents, injuries, and deaths for Brazil was between BRL 170 to BRL 258 billion in 2013, depending on the method of estimation employed.<sup>1</sup> A recent estimate, updating a study from 2006, carried out by the Brazilian Institute of Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada* IPEA) and the Federal Highway Police, indicates an economic cost of traffic accidents of BRL 12 billion, just on federal roads. Moreover, the economically disadvantaged are overrepresented among road crash victims, with downward economic pressure on families due to the loss or disability of the family breadwinner.

The key risk factors for road safety in Brazil, as well as in many other countries, are identified as follows: (i) excessive travel speeds; (ii) drink driving; (iii) inadequate use of motorcycle helmets; (iv) low rate of use of seatbelts; (v) road infrastructure that is not designed based on the “safe system,” and; (vi) safety vehicle norms that do not meet recommendations.

#### *How did this situation emerge?*

**Since the beginning of 2000, the motorization rate in Brazil has increased tremendously, particularly the number of motorcycles.** The motorization rate increased 12.5 percent per year on average from 2001 to 2012. Even more alarming was the number of motorcycles, with

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<sup>1</sup> Based on the estimated proportion of GDP lost and the estimated cost from the International Road Assessment Program (iRAP) using a multiplier of 70 times GDP per capita for fatalities and 17 times GDP per capita for serious injuries, applied to numbers of deaths and serious injuries from the adjusted DataSUS figures (iRAP 2009, *The True Cost of Road Crashes: Valuing life and the cost of serious injury*).

an average increase of more than 30 percent per year from the 2001 baseline. The fleet of the other vehicles barely doubled from 2001 to 2012, while the fleet of motorcycles increased three-fold: in 2012, of the roughly 76 million motorized vehicles in Brazil, about 20 million were motorcycles. This increase in motorization and circulation had a noticeable impact on the number of accidents, serious injuries, and deaths on the roads.

**Brazil suffers from an absence of enshrined leadership of road safety**, due to the absence of effective management structures for road safety and insufficient power assigned to road safety staff where they do exist in core delivery organizations. The absence of a lead agency stands out as a key omission in Brazil's road safety management. There is no single institution with appropriate functions, powers, funding, resources, staff, and accountability to lead, manage, coordinate, facilitate, motivate, and monitor the disparate road safety activities of government agencies and other bodies. Furthermore, Brazil has a National Road Safety Strategy for 2004-2014, but this strategy is little known and underutilized.

**The absence of a comprehensive and complete national crash database is a profound impediment** to setting national goals, monitoring progress, and ensuring effective advocacy regarding the importance of road safety. Of all crash data collection and storage systems in Brazil, no one system meets the core criteria required of such a system to provide a full and effective data source about accidents. Consequently, due to the lack of data, evaluation of road safety programs is rare. Furthermore, there is little demand for evaluation, in that road safety interventions are often implemented without a clear analysis of the "before" situation or systematic data collection about the "after" for evaluation.

**The absence of clear leadership has led to limited coordination among agencies.** Vertical coordination at the national–state level is concerning since there is little uniformity in road safety policy and practice between federal and state governments. Furthermore, the number and size of the smaller municipalities presents a significant impediment to road safety on local roads since such tiny municipalities are not only unable to provide municipalized traffic, but are insufficiently resourced and funded to manage the basic safety of their road networks.

**Although the current legislative and regulatory framework for road safety improved in recent years, many work fronts remained unsupported.** For example, while some penalties have been appropriately raised recently, many penalties have not increased to keep pace with inflation or the overall increasing wealth in Brazil, resulting in fines that are too low to serve as an effective deterrent. Effective enforcement of drink driving laws, even with the current "dry law," remains a challenge because drivers can still refuse the breath test. Other problems with current practice relate to the processing and management of penalties, in that offenders are able to delay paying fines for long periods with little consequence.

**Road safety funding at all levels of government is uncertain.** In federal and state governments, road safety is typically funded from the consolidated funds of road and other agencies, although an amount is not specifically allocated to road safety by the government. The actual amount spent on road safety is determined by internal budgetary arrangements within agencies. Investment in road safety is not sustainably regulated and does not appear

to be commensurate with the size of the problem and its attendant economic, human, and social costs.

**In Brazil, there are many education and awareness programs targeting traffic safety, some of which are well designed and implemented, but these programs lack global systematization.** To address this deficiency, a systematic communication strategy is needed to promote road safety and to increase risk awareness and improve on-road behavior. In addition, pressure from the population to reduce the high level of crash risk and to demand road safety improvements by the government is rare in Brazil, but of great value to enhance political ownership of road safety.

**Brazilian road infrastructure does little to integrate the notion of “safe systems,” which that presumes that drivers will make mistakes. “Safe Systems” target a reduction of the severity of accidents, when they occur.** Brazil has a wide variety of road types, with highly variable safety standards. Globally, infrastructure managers dedicate considerable efforts (and budget) to improving the condition of pavements and pay very little attention to roadsides. However, the shoulders and roadside barriers in particular allow for the reduction of accident severity based on the “safe systems” concept. Therefore, although programs like “BR-Legal” of the Brazilian national department for transport infrastructure (*Departamento Nacional de Infraestrutura de Transportes, DNIT*) have produced results, road infrastructure management, in terms of road safety, cannot be limited to signage and should have a more holistic focus to ensure greater safety. Current investment in road safety is modest in comparison to the potential benefits obtained.

**Brazil could draw more heavily on international road safety practices to identify solutions.** International experience regarding most aspects of road safety (the laws of physics, roadside barriers, roundabouts, signals, road design, vehicle safety ratings) can largely be adapted to the Brazilian context, with some adjustments. Furthermore, the lack of universities and academics focusing on road safety at the national level constitutes a challenge for Brazil’s road safety agenda.

**Vehicles manufactured for the domestic market often follow lower safety standards than vehicles that were manufactured in Brazil for the international market.** Standard vehicular safety norms are gradually improving with, for example, the recently introduced norms for motorcycle breaks. However, the gap with European and American standards is important.

### *Recommendations*

Based on these conclusions, the review identified the following 14 areas of significant opportunity for road safety improvement in Brazil.

**1: Institutional Leadership, Management Capacity, Coordination and Culture Change.** Establish a new national lead agency for road safety to take global responsibility for road safety and lead the agenda, with adequate oversight of government stakeholders, ideally reporting to the President of Brazil.

**2: Crash Data Systems Development.** Create a sound, comprehensive nationwide road safety crash database, covering all roads and including the crash details required for informed management and progress monitoring.

**3: Funding and Resource Allocation.** Provide sustainable, appropriate funding to facilitate implementation of road safety programs.

**4: Results Focus, Monitoring and Evaluation.** Create a nationwide road safety results-focused culture across governments, with evidence-based decisions (databases), accountability, stronger performance criteria, and targets.

**5: Research, Development, and Knowledge Transfer.** Develop technical and management capacity for staff on road safety across federal, state, and municipal agencies.

**6: Multisectoral Promotion, Advocacy, and Education for Road Safety.** Provide structured programs that are systematic and evidence based, representing best practice in road safety promotion and education in Brazil by NGOs, private enterprises, and the education sector.

**7: Road Safety Delivery by States and Municipalities.** Increase the capacity and motivation of municipalities, and create more stable partnerships with states for road safety delivery.

**8: Management of the Road Network.** Fully integrate the road safety dimension into existing and planned road infrastructure with the following order of priority: (i) roadside works that prevent injury or death (such as barriers); (ii) works that restrict speeds to reduce crash force (such as speed humps); (iii) works that help the road user avoid making errors (such as signs and lines).

**9: Management of Road User Behavior.** Improving on-road behaviors requires scaled up and less lenient enforcement, especially in rural communities, to address punishment avoidance and delays in order to make enforcement more effective, in addition to adopting a graduated licensing scheme.

**10: Management of Travel Speeds.** Manage speeds better through lower speed limits, engineering, comprehensive and aggressive enforcement, and strong media and communications campaigns to combat misperceptions that speeding is not a safety issue and that speed cameras serve as a source of revenue.

**11: Management of Motorcycle Safety.** Improve the safety of motorcycle riders through a number of mechanisms, including motorcycle blackspot programs, motorcycle lanes, banning lane-splitting, specifically targeted speed enforcement, and zero tolerance for noncompliance with the requirement to wear helmets with chin straps.

**12: Management of Vehicles.** Enhance the safety of the fleet of vehicles through regulation requiring higher safety standards, financial incentives and robust fleet purchase policy.

**13: Recovery and Rehabilitation of Crash Victims.** Improve coordination and cooperation in emergency response delivery, in particular by having only one emergency number.

**14: Reduced Road Use.** Include road safety in the economic evaluation of alternatives in transportation projects, promoting alternative transport modes (for example, public transport, non-motorized transport, and railway transport, among others).

# 1 INTRODUCTION

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## 1.1 BRAZIL'S TRANSPORT CONTEXT

Brazil occupies around half of the continent of South America covering a total land area of 8,456,510 km<sup>2</sup>. In contrast to the Andes mountains with elevations well over 6,000 meters, most of Brazil is geographically flat, with the Amazon River Basin occupying a large proportion of the country. Only about 0.5% of the country is above 1,200 m elevation. The population of Brazil is about 200 million people, which places Brazil fifth in the world in population. Brazil is also the eighth largest world economy (2015).

Brazil has around 1.6 million km of road network, with about 85% unpaved.<sup>2</sup> Only 8% of the road network are dual-carriageway highways. The higher road density is found on the coastal fringe, where most of the country's population is located. The majority of the road network is managed by the municipalities (about 1.3 million km), while the federal and state road networks are respectively about 76,000 km and 120,000 km.<sup>3</sup> Road is the dominant transport mode in Brazil. It is estimated that about two-thirds of the cargo are transported on Brazil roads. The proportion is even higher for passenger transport, even if air transport gained market shares over the past years.

Motorization rate has steeply increased over the past years. The motorization rate has increased on average by 12.5% annually from 2001 to 2012. Even more alarming, the number of motorcycles has sky-rocketed, with an increase averaging over 30% per annum from the 2001 baseline. The non-motorcycle fleet has a little more than doubled from 2001 to 2012, while the motorcycle fleet has increased over three fold. In 2012, there were about 76 million motor vehicles in Brazil, out of which about 20 million were motorcycles. These elements related to the rate of motorization are key to understand the Road Safety situation in Brazil.

## 1.2 THE GLOBAL ROAD SAFETY SITUATION

According to World Health Organization (WHO) estimates, in 2013, 1.25 million people died on the world's roads and in addition up to 50 million were injured. Road traffic crashes are the eighth leading cause of death globally, and the leading cause of death for people aged 15–29.<sup>4</sup> Estimates from the World Bank now reflect increased trauma and suffering to around 1.3 million deaths and 82 million non-fatal injuries warranting medical treatment per year<sup>5</sup>.

The burden of road related trauma is extremely unevenly distributed, with over 90% of road fatalities occur in low-income and middle-income countries. Disturbingly, the gap is widening:

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<sup>2</sup> Source: Presentation by Romeu Sceibe at International Workshop on Road Safety Brasilia, November 2014.

<sup>3</sup> From DNIT's website, March 2015.

<sup>4</sup> WHO (World Health Organization) (2013) Global status report on road safety 2013: Supporting a decade of action. WHO: Geneva.

<sup>5</sup> Bhalla, Kavi; Shotten, Marc; Cohen, Aaron; Brauer, Michael; Shahraz, Saeid; Burnett, Richard; Leach-Kemon, Katherine; Freedman, Greg; Murray, Christopher J. L.. 2014. Transport for health: the global burden of disease from motorized road transport. Washington, DC: World Bank Group. <http://documents.worldbank.org/curated/en/2014/01/19308007/transport-health-global-burden-disease-motorized-road-transport>

most of the improvement in road deaths is occurring in high income countries while the situation in low and middle income countries overall is worsening, primarily due to increasing motorization. In 2004, road traffic injury was the ninth leading causes of death, and 8<sup>th</sup> leading cause in 2010, but it is estimated by WHO that by 2030, without concerted action, road traffic will be at fifth place ahead of such diseases as tuberculosis and HIV/AIDS.<sup>6</sup> Road traffic injuries are already among the three leading causes of death for people between 5 and 44 years of age. Furthermore, as the WHO noted, the economically disadvantaged are most affected by road crashes and trauma. Families are driven into poverty by the loss of the breadwinner. In low and middle income countries, many families rely on males as breadwinners and males are disproportionately at risk of death and disabling injury in traffic crashes. In Brazil, 81% of fatally injured road crash victims are males.

WHO estimated that the economic costs of motor vehicle crashes were between 1% and 3% of the GDP of the world's countries. However, more recent analyses of costs of crashes employing improved methods (based on value of a statistical life year)<sup>7</sup> suggest that this may be a dramatic under-estimate with estimated costs for low and middle income countries rising as high as 5% to 8% of GDP<sup>8</sup>. These estimates cover the many aspects of costs of crashes: emergency response, health care and rehabilitation costs, lost income during recover or due to death, lifetime care for the disabled, and property damage costs. It is of great concern that the latter estimate of 5-8% of GDP would be a reasonable estimate of costs for Brazil. The present report employs the latter estimate and other methods to estimate costs for Brazil.

### 1.3 THE UNITED NATIONS DECADE OF ACTION FOR ROAD SAFETY 2011-2020 AND FUTURE PLANS

In March 2010, the United Nations unanimously proclaimed the Decade of Action for Road Safety 2011-2020 with the goal of stabilizing the increase and reducing global road deaths. Resolution 64/255<sup>9</sup> also invites all Member States to set their own national road traffic casualty reduction targets to be achieved by the end of the Decade, in line with a global plan of action to be prepared by the World Health Organization and the United Nations regional commissions, in cooperation with other partners in the United Nations Road Safety Collaboration.

The United Nations Global Plan for the Decade of Action for Road Safety 2011-2020<sup>10</sup> is based on the Safe System approach described below. In 2009 and again in 2013, WHO published

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<sup>6</sup> WHO (World Health Organization) (2013) Global status report on road safety 2013: Supporting a decade of action. WHO: Geneva. [www.who.int/violence\\_injury\\_prevention/road\\_safety\\_status/2013/en/](http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/)

<sup>7</sup> McMahon, K & Dahdah, S. (2008). The True Cost of Road Crashes: Valuing life and the cost of serious injury. iRAP: Hamshire, UK. <http://www.irap.org/about-irap-3/research-and-technical-papers?download=45:the-true-cost-of-road-crashes-valuing-life-and-the-cost-of-a-serious-injury-espaul>.

<sup>8</sup> Dahdah, S and Bose, D (2013). Road Traffic Injuries: A Public Health Crisis in the Middle East and North Africa. Transport Notes TRN-45. October 2013. World Bank, Washington DC. <http://siteresources.worldbank.org/INTTOPGLOROASAF/Resources/TN-MENA-Road-Safety-Dahdah-and-Bose-revised-print.pdf>

<sup>9</sup> United Nations (2010). Resolution 64/255 Improving global road safety. New York.

<sup>10</sup> United Nations (2011). Global Plan for the Decade of Action on Road Safety 2011-2020. Geneva: WHO. [http://www.roadafetyfund.org/UnDecadeOfAction/Documents/global\\_plan\\_en.pdf](http://www.roadafetyfund.org/UnDecadeOfAction/Documents/global_plan_en.pdf)

Global Status Reports<sup>11</sup> on Road Safety that showed that significantly more action is needed to make the world's roads safer. In low and middle income countries, action is needed on all fronts: roads and road-sides, speeds, vehicles and equipment, and behavior.

In September 2015, the UN General Assembly approved within the Objectives of Sustainable Development, two specific targets for Road Safety. The first target (Target 3.6) is to divide by two, by 2020, the number of deaths and injuries from traffic accidents. The second target (Target 11.1) mentions explicitly the improvement of Road Safety.

In November 2015, Brazil will host the Ministerial mid-term review of the United Nations Global Plan for the Decade of Action for Road Safety 2011-2020. Work is already underway on reviewing the Global Plan as well as progress towards the decade's goals.

#### 1.4 THE SAFE SYSTEM APPROACH

The Safe System approach<sup>12</sup> accepts that people will make mistakes and the road toll will never be solved simply by improving the behavior of road users. Thus, within this approach, the managers of the system (roads, roadsides, vehicles, and people) identify and rectify the major sources of risk or design weakness that contribute to fatal and serious road crashes to mitigate the severity and consequences of crashes. No longer can system operators rely on measures designed to improve the behavior of road users or designed to reduce human error. A key principle is that the road transport system must be designed to accommodate the human failings that lead to crashes, injuries and deaths. Road design and especially roadside protection (such as barriers) must take account of the biomechanical limits of the human body and better manage crash forces down to levels which are not beyond those the human body can withstand, even in the event of human error leading to a crash. This can be achieved for example by determining speed limits that allow the use of the road to occur without death even in the inevitable event of human error. However, this does not mean that road users are no longer to be responsible for their actions or that they can ignore traffic rules, especially speed limits and the need to use seatbelts and helmets.

#### 1.5 WORLD BANK AND OTHER PARTNERS FOR ROAD SAFETY IN BRAZIL

Brazil and the World Bank have been in partnership in the area of transport for the past 50 years with an ever increasing focus on Road Safety. Most recent Road Safety projects have included Road Safety management capacity reviews of the states of Sao Paulo, Rio Grande do Sul, and Bahia. Several loans from the World Bank to State and local governments in Brazil also include Road Safety investments and capacity building. The present Capacity Review at a national level is a critical opportunity to review and revise Road Safety at the federal level.

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<sup>11</sup> WHO (World Health Organization) (2009) Global status report on road safety: time for action. World Health Organization: Geneva, &

WHO (World Health Organization) (2013) Global status report on road safety 2013: Supporting a decade of action. WHO: Geneva.

[www.who.int/violence\\_injury\\_prevention/road\\_safety\\_status/2013/en/](http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/)

<sup>12</sup> ACRS (2010). Fact Sheet: Safe System Approach. Publication of the Australasian College of Road Safety: Canberra. Available at: <http://www.roadsafetytrust.org.au/c/rtt>

The central role of Federal Government in Road Safety dictates that activity at the national level is critical to achieving sustained improvement in Road Safety results in Brazil.

Road Safety in 10 Countries (RS10) is coordinated by WHO, Global Road Safety Partnership (GRSP), International Injury Research Unit (Johns Hopkins University), World Bank, EMBARQ and ASIRT and is funded by the Bloomberg Family Foundation. The RS10 is known in Brazil as Project Vida no Trânsito (PVNT), where the overall goal is to support the Government of Brazil to implement good practices in Road Safety in line. The World Health Organisation/Pan-American Health Organization (WHO/PAHO) is overseeing assessment. The project includes promotion of Road Safety as a key issue for the cities, co-ordination of data and information use as well as actions, and ongoing evaluations of outcomes.

iRAP (International Road Assessment Program) assessments are in use in Brazil to evaluate the safety and risk of roads and guide engineering programs for improved safety, supported by funding from the World Bank – federal level, Sao Paulo state, and in preparation in the states of Rio Grande do Sul and Bahia.

The recently announced program of Bloomberg support for Road Safety also includes a focus on two cities in Brazil: Sao Paulo and Fortaleza.

## 2 REVIEW DESCRIPTION

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### 2.1 APPROACH TO THE REVIEW

The primary objective of this review is to carry out a multi-sectoral capacity assessment of Road Safety management in Brazil, including all levels of Government and non-government. The approach to the Review ensures the analysis undertaken, diagnosis provided, and recommendations made are, as far as possible, derived from a rigorous scientific evidence base. The key functional aspects (including those identified by the World Bank Guidelines) of Road Safety are examined within the Review are:

- Lead agency (OLN) role and institutional management functions;
- Results focus at the system level (including crash data systems);
- Coordination;
- Legislation;
- Funding and resource allocation;
- Promotion and education;
- Monitoring and evaluation;
- Research and development and knowledge transfer;
- Capacity to deliver results over the elements of the system to be managed:
  - Planning, design, maintenance and operation and use of the road network.
  - Management of vehicles on the road network.
  - Management of road users on the road network.
  - Management of travel speeds on the road network<sup>13</sup>.
  - Recovery and rehabilitation of crash victims from the road network.
  - Encouraging and facilitating reduced road use<sup>15</sup>.

### 2.2 AIMS OF THE REVIEW

The ultimate expected outcomes of this Review are to assist Brazil to enhance its strategic framework, improve management, and delivery capacity for Road Safety. This will facilitate improved efficiency and sustainability of Road Safety activities and contribute to the achievement of the ambitious Road Safety goals set within the United Nations Decade of Action<sup>14</sup>, as supported by Brazil. Specific outcomes of the Review include:

- Sharing best evidence-based practices and international experience in Road Safety strategic planning and management based on the Safe System approach;
- Guiding future Road Safety management structures, functions, accountabilities, and responsibilities;
- Providing an action plan containing recommendations for better capacity of key stakeholders to plan, coordinate, manage, monitor and deliver effective Road Safety activities.

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<sup>13</sup> An added factor to the World Bank guidelines

<sup>14</sup> United Nations (2011). *Global Plan for the Decade of Action on Road Safety 2011-2020*. Geneva: WHO. [www.who.int/roadsafety/decade\\_of\\_action/plan/plan\\_english.pdf](http://www.who.int/roadsafety/decade_of_action/plan/plan_english.pdf)

## 2.3 SCOPE

The scope of the review includes the management of *all road* traffic crashes and trauma within Brazil. Thus, it includes crashes on all public roads and road related areas be they state, federal or municipal. It is critical for the people of Brazil, as well as the Federal Government, to have an overall performance measure for Road Safety and a broad understanding of the extent of the problem as well as a measure of the costs of road crashes and trauma.

## 2.4 REVIEW METHODOLOGY

Carrying out a systematic review of Road Safety management capacity is a recommended step in determining an integrated multi-sectoral framework for dialogue and partnership between different partners on a potential Road Safety improvement program including Road Safety related investments, according to the World Bank Global Road Safety Facility Guidelines<sup>15</sup> and update.<sup>16</sup>

The Review is based on:

- Analysis of existing Road Safety data, including documents, forms, and systems employed in Road Safety record keeping and management;
- Extensive interviews of key Road Safety stakeholders at federal, state and municipal levels, members of parliament, NGOs, and the private sector;
- Written answers to a brief questionnaire by additional stakeholders;
- Direct inspection of roads and on-road behaviors in many states of Brazil;
- Analysis of published research and reports on Road Safety in Brazil and in various states.

It includes information and understanding gained from previous reviews of the states of São Paulo, Rio Grande do Sul, and Bahia as well as the national review. Additional information gathering and Road Safety safe systems promotional processes included:

- Informal and formal review of roads, speed limits, and roadside infrastructure were undertaken by Soames Job as part of this review, previous reviews, and travel in Brazil, including reviews of many capital cities, many smaller cities, and villages, federal and state highways, rural, remote rural roads, and remote unpaved roads in many states: Amazonia, Bahia, Ceará, Goiás, Rio de Janeiro, Rio Grande do Sul, São Paulo, Santa Catarina, Tocantins, and the Federal District;
- Small scale observational surveys in many suburbs of the above cities, villages, highways and rural roads to gain impressions of: (i) seat belt and child restraint usage rates; (ii) motorcycle helmet wearing rates, and; (iii) bicycle helmet wearing rates;
- Reviews of travel speeds on the above roads, and formal speed surveys.

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<sup>15</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specification of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C.

<sup>16</sup> Bliss T. Breen, J. (2013) Road Safety Management Capacity Reviews and Safe System Projects Guidelines Updated Edition Washington, DC: Global Road Safety Facility.

## 3 ROAD SAFETY SITUATION IN BRAZIL

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### 3.1 BACKGROUND AND NATIONAL SITUATION

Many valuable effective Road Safety management programs and practices exist in Brazil (at federal, state and municipal levels of government and by NGOs) but, overall, Road Safety management is fragmented.

Brazil has a national Road Safety strategy for 2004-2014<sup>17</sup>, but interviews carried out as part of this Review revealed that this strategy is little known and little used. No Road Safety stakeholder in Brasilia (or in other previous Reviews, in Rio Grande do Sul or Sao Paulo or Bahia) referred to it, unless explicitly asked by the Review team.

Globally, national trends since the early 2000s for rapidly increasing motorization, especially by motorcycle, are correlated to the increasing road trauma. In this context, and as detailed below, 2013 appears to be an exception, with a reduction of the number of deaths between 2012 and 2013. Looking ahead, it will be interesting to monitor whether 2013 was an exception in a globally increasing trend, or the beginning of an improvement of Brazil's Road Safety outcome.

### 3.2 INSTITUTIONAL CONTEXT

#### *Federal Level*

At the federal level, the key ministries with Road Safety responsibilities include the ministry of cities, the ministry of transports, the ministry of justice, and the ministry of health. There is no interministerial committee or lead agency (OLN) to define, and coordinate Brazil's Road Safety policy.

The **Ministry of Cities** hosts the national traffic department (DENATRAN – *Departamento Nacional de Trânsito*). In the current organization, this department would be the primary entity in charge of Road Safety, being responsible, among others, for the Brazilian Traffic Code (*Código de Trânsito Brasileiro*). In spite of CTB, its Road Safety specific role is actually quite limited, intervening mainly through ad-hoc education and communication campaigns.

The **Ministry of Transport** is responsible for the federal road and highways. The National department for transport infrastructure (DNIT – *Departamento Nacional de Infraestrutura de Transportes*) is the agency, reporting to the ministry of transports, in charge of managing the federal highway network. As such, DNIT is a key element of Road Safety in Brazil. While its focus has been mainly (and still is) on the infrastructure condition, DNIT has recently turned to traffic management and Road Safety. In particular, DNIT has implemented, for a couple of years the “BR Legal” program, aiming at safer roads.

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<sup>17</sup> See targets sets for the strategy for 2004-2014, referenced in WHO (World Health Organization) (2013) *Global status report on road safety 2013: Supporting a decade of action*. WHO: Geneva.

The **Ministry of Justice** responsibility is primarily of traffic law enforcement, through the federal highway police (*Policia Rodoviaria Federal – PRF*), covering federal highways and, under some condition, some State highways.

Finally, the **Ministry of Health** is responsible for the post-crash response. This ministry also manages the database, officially used to assess Road Safety outcomes.

**CONTRAN** (*Conselho Nacional de Trânsito*) is a federal committee assisting in coordinating transport and traffic-related issues, *a priori* including Road Safety. DENATRAN's Director heads this Committee, which is comprised of representatives from the following ministries: cities, justice, transport (including its land transport regulation agency), defense, education, health, science technology and innovation, environment, development, industry and trade.

### *Subnational Level*

The State level includes similar institutions and organization as the ones existing at the federal levels. Typically, State administrations include:

- A transport department (DETRAN – *Departamento de Transito*), which may be attached to different entities, depending on the State (e.g.: *Secretaria de governo, Secretaria de Administracao*). The primary responsibility of these DETRANs is to enforce the Brazilian Traffic Code (CTB). This include, among others: vehicles and drivers licensing.
- An infrastructure secretariat, with primary responsibility on roads and highways;
- A public security secretariat, undertaking the enforcement responsibilities, relying on state police.
- A health secretariat, in charge of health issues at the State level, including – depending on the State considered - emergency services coordination, or a fraction thereof.

At municipal level, similar organizations are found, with a highly variable capacity depending on the size of the municipality. The many municipalities in Brazil, often with low capacity in remote areas, compound Road Safety management challenges.

Typically, and exemplifying coordination issues between jurisdictions, Brazil has many police types that could be involved in traffic law enforcement: federal highway police, state highway military police, state civil police, technical and scientific police.

### *Non-governmental Road Safety organizations*

Overall, Non-Governmental Organizations promoting Road Safety are seldom in Brazil. While some states have active Road Safety NGOs, in other states, the only active NGOs for Road Safety are funded by Government and, thus, limited in their demands for Road Safety. Examples of active and valuable advocacy is occurring include the National Observatory (*Observatorio Nacional de Seguranca Viaria*), the *Kidsafe* program, the Brazilian Association of Traffic Accident Prevention.

### 3.3 ROAD SAFETY OUTCOMES IN BRAZIL

#### *Global Road Safety toll in Brazil*

The Health ministry database (DataSUS) is the only database with official records of all deaths on Brazil's roads. It reports 45,751 deaths and over 188,000 serious injuries in 2012, dropping, for the first time in some years, to 42,266 deaths in 2013.

**Table 1: Total numbers of traffic crash deaths and serious injuries for Brazil (Source: From National Observatory, which in February 2015 was only able to provide data up to 2012 from DataSUS. The figure for 2013 is from the Ministry of Health<sup>18</sup>)**

Year	Deaths	Serious Injuries
2013	42,266	
2012	45,751	188,547
2011	44,137	146,322
2010	43,606	149,191
2009	38,116	126,368
2008	38,827	106,408
2007	37,907	108,837
2006	36,808	104,939
2005	36,295	103,022
2004	35,358	95,607
2003	33,315	91,378
2002	32,937	96,165
2001	30,723	97,109
<b>Increase from 2001 to 2012</b>	<b>49% (37% to 2013)</b>	<b>94%</b>

However, it is assessed that data losses occur (e.g.: through non-transfer of data or inaccuracies from hospitals/municipalities). No database exists which provides the full picture of road crashes for the entire country; the World Health Organization<sup>19</sup> estimated that the official DataSUS numbers understated deaths by 20%. Incomplete coverage of the data is being progressively addressed, and thus it is likely that the proportion of omissions has decreased over years, contributing somewhat to the recorded increase in deaths and serious injuries.

Numerous, sometimes quite incomplete, crash databases exist for segments of the Road Safety problem: federal roads, state roads in each state, and some municipalities with some efforts to collate these at the state level. Few of these many databases have a primary focus on understanding and monitoring Road Safety outcomes. For example, the Lider *DPVAT* insurance claims database would provide national coverage; yet, this database contains other issues such as fraudulent claims, missed cases due to at fault deaths and uninsured vehicles, and claims not occurring in the year of the crash with the data recorded by year of the claim.

<sup>18</sup> Source: Deaths for 2013 were only released in June 2015 by DataSUS, just before this report was finalised and further details for 2013 were not available.

<sup>19</sup> WHO (World Health Organization) (2013) Global status report on road safety 2013: Supporting a decade of action. WHO: Geneva

The Review team evaluated substantial difference between the number of fatalities estimated from the Lider DPVAT database and from DataSUS, calling for further investigation.

DataSUS numbers for fatalities result in deeply concerning death rates of 23.6 per 100,000 population in 2012 (based on a population of 194 million) and a rate of 20.6 for 2013 (based on a population of 196 million).

### *International Comparisons*

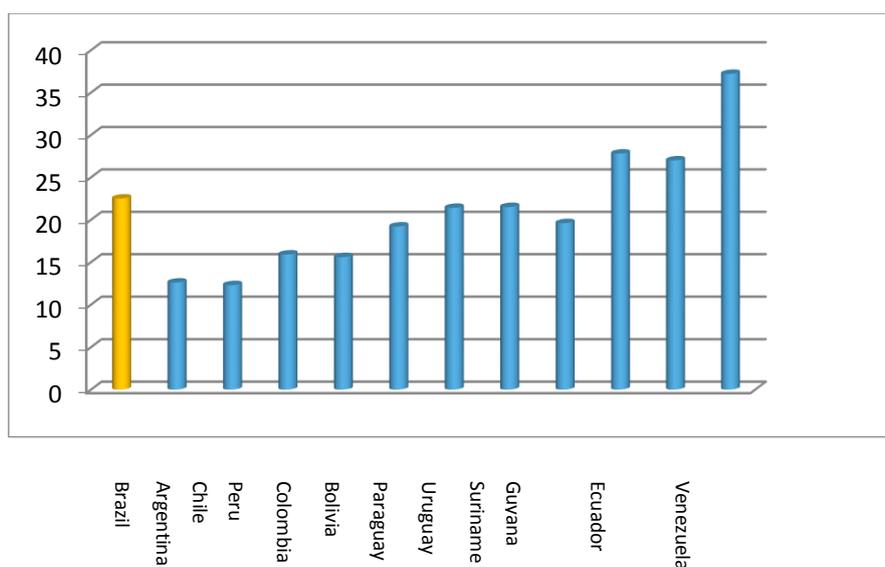
Brazil road fatality rate is considerably higher than the one of best performing countries, such as Sweden, Netherlands and Great Britain. The three countries are all around 3 deaths per 100,000 population, leaving Brazil at around 7 times the death rate of these countries. While it is acknowledge that higher population densities make Road Safety management easier, Australia, which shares some features with Brazil (in terms of population density), shows much better Road Safety outcome: the overall death rate in Australia is 5.2 and the best state (New South Wales) was 4.1 in 2014.

However, there are also many countries with worse Road Safety performances than Brazil as identified in the WHO Global Status Report. Comparison with the countries of South America suggests that Brazil is performing somewhat more poorly than the continent generally, while Argentina and Chile are performing better than the rest of South America (See Figure 1, which employs the WHO data as a uniform source).

### *Fatalities and casualties by road user group*

According to DataSUS, overall in Brazil, 81.8% of deaths are male; across states, between 75 to 87% of fatalities are male. In addition, younger adults are over-represented among the victims, with every state have the categories of 30-39 or 18-24 years old as the age group with the highest number of deaths.

**Figure 1. Road crash deaths per population (vertical axis, in 100,000s) for countries in South America<sup>20</sup>.**



<sup>20</sup> Data from WHO, 2013, which has no data from French Guiana.

Table 2 shows the lethal nature of motorcycles (which are 26.4% of the motorized fleet, but constitute 52.0% of motorized vehicle occupant deaths, and an alarming 82.6% of seriously injured motorized vehicle occupants). Also, the number of cases for which information is not available highlights the limitations of a health system based road crash injury database. Finally this Table and those above reveal a most unlikely ratio of deaths to serious injuries, of around 1 to 4.5. The expected ratio would be much higher (more than double this figure), which suggests a large degree of non-reporting of even significant injuries.

**Table 2: Brazil's Road Traffic Deaths and Serious Injuries by Road User Type.<sup>21</sup>**

Vehicle	Deaths	Serious Injuries
Cars	10,525	16,153
Truck and Bus	1,056	1,048
Motorcycle	12,544	81,455
<b>TOTAL MOTORIZED VEHICLE OCCUPANTS</b>	<b>24,125</b>	<b>98,656</b>
Bicycles	1,492	8,831
Pedestrian	8,819	40,426
Others	356	-
Not Available	10,897	29,574
<b>GRAND TOTAL</b>	<b>45,689</b>	<b>177,487</b>

The above analysis is consistent with Chandran et al.<sup>22</sup> who noted the disturbing trend that the proportion of Brazil's road deaths who are pedestrians and motorcyclists is increasing, and the analysis by Vasconcellos<sup>23</sup> which pointed to the unsustainable cost of motorcycle transport for Brazil, and the University of Michigan Transportation Research Institute's analysis of Brazil's Road Safety challenges.<sup>24</sup> Motorcycle and pedestrian safety issues must be specifically targeted for serious improvement.

#### *Road Safety outcomes across states*

Large variations in Road Safety outcomes exist across states. Relevant data comparing the states (derived from various sources but mostly from DataSUS) are presented in Table 3. These data highlight the variation in Road Safety performance, the nature of the main problems, and some of the underlying factors contributing to the level of Road Safety achieved. Noteworthy features include:

- Most casualties are reported in the South-East Region (over 16,000) with the least in the North (at 3,800). However, these differences reflect total populations of regions and the South-East has the lowest death rate per 100,000 people (at 19.8);

<sup>21</sup> Source: National Observatory, 2012 data- the latest available on the Statistical Portal

<sup>22</sup> Chandran A, et al. (2012). Road traffic deaths in Brazil: rising trends in pedestrian and motorcycle occupant deaths. *Traffic Injury Prevention, 2012;13* Suppl 1:11-6.

<sup>23</sup> Vasconcellos E.A. (2012) Road safety impacts of the motorcycle in Brazil. *International Journal of Injury Control and Safety Promotion*. <http://www.tandfonline.com/loi/nics20>

<sup>24</sup> Vasconcellos, EA Sivak, M. (2009). Road safety in Brazil: Challenges and opportunities. Report No. UMTRI-2009-29 August 2009

- The most dangerous region for road deaths is the Mid-west with 31.9 deaths per 100,000 people;
- One predictor of death rate is the proportion of motorcycle deaths: regions and states with higher proportions of their deaths as motorcyclists tend to have worse overall death rates. For example, three states (Piauí, Roraima, and Sergipe) suffer over 60% of road deaths being motorcyclists, and all three states have much higher than average death rates (38.3, 31.7, and 30.8 respectively, versus the national average of 23.6 deaths per 100,000);
- The best performing Road Safety states on a population rate basis tend to be those with higher average incomes and higher human development indices (such as Sao Paulo, with 17.3 deaths per 100,000 people) and those with less road network and more reliance on water based transport (such as Amazonia with 12.8 deaths per 100,000 people);
- When the worst performing states are selected on the basis of deaths per 10,000 vehicles (as a guide to deaths as a proportion of road use) the worst performing Road Safety states are different: Three states (Alagoas, Maranhão, and Piauí) reach over 15 deaths per 10,000 vehicles compared with the national average of 6.0.

**Table 3: Official Road Safety Statistics (deaths, injuries) and Exposure Statistics (population, vehicle, road length) by Region.**

Region/ States	Number of Deaths	Number of Serious Injuries	% of Deaths by Motorcycle	Population in 2010 (million)	Vehicle Fleet (Total Number)	% of Fleet which are Motorcycles	Total Road Network in 2014 (km)	Federal Road Network (km)	State Road Net-work (km)	Deaths per 100,000 People <sup>0</sup>	Deaths per 10,000 Vehicles <sup>1</sup>	% of Deaths who are Male <sup>2</sup>	Average Age and (%) of highest age category for those Killed <sup>3</sup>
<b>MIDWEST</b>	4,594	17,221	36.51%	14.06	6,937,476	29.81%	205,474.00	11,161	15,360	31.90	6.62	80.79%	30-39 (20.60%)
<b>NORTHEAST</b>	13,545	57,005	48.15%	53.08	11,937,607	42.82%	445,560.80	19,288	33,858	25.10	11.35	84.44%	30-39 (21.59%)
<b>NORTH</b>	3,800	15,887	39.27%	15.86	3,573,678	46.94%	147,791.70	8,235	11,205	23.40	10.63	80.97%	30-39 (20,35%)
<b>SOUTHEAST</b>	16,148	75,979	27.84%	80.36	38,277,023	20.83%	533,607.70	14,469	32,759	19.80	4.22	81.11%	30-39 (19.16%)
<b>SOUTH</b>	7,664	22,455	31.35%	27.37	15,409,176	21.08%	388,179.70	11,768	17,660	27.70	4.97	79.43%	18-24 (18.65%)
<b>BRAZIL</b>	45,751	188,547	36.16%	#	76,134,910	26.38%	1,720,614	64,921	110,842	23.60	6.00	81.77%	

### 3.4 ESTIMATING THE COST OF CRASHES IN BRAZIL

This section provides estimates of costs based on the application of two international methodologies relevant to Brazil: an estimate of the costs as a percentage of GDP, and an estimate of the costs of deaths and injuries relative to GDP per person. Recent developments in costing methods<sup>25</sup> have changed our understanding of the economic burden of serious crashes and thus earlier studies of the costs of crashes in Brazil<sup>26</sup> may present a significant underestimate of costs. These are estimated for 2013, as required data exist for that year and it is acknowledged that these are approximate estimates.

As a middle income country, it is reasonable to expect that road crashes cost as much as 5% to 8% of GDP in absolute economic terms based on recent costing methods. Taking 5% of GDP for Brazil (about BRL 5,158 billion<sup>27</sup>) yields an estimated cost of road trauma for the state of over BRL 258 billion. An alternative approach is to assess costs of crashes from estimated numbers of deaths and serious injuries. iRAP provides such an estimate (multipliers of 70 times GDP per capita for fatalities, and 17 times GDP per capita for serious injuries<sup>28</sup> with GDP per capita of BRL 25,655 for 2013<sup>29</sup>). Applying these costs results in a cost estimate of BRL 1.80 million per death and BRL 0.44 million per serious injury. For the 45,436 deaths and 203,631 serious injuries as estimated above based on DataSUS, the estimated road cost is about BRL 170 billion for these aspects of crash cost alone. These disparate estimation methods produce significantly different results (with the lower figure not including cost for minor injury crashes and property damage) suggesting crash costs between BRL 170 and BRL 258 billion for 2013 in Brazil.

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<sup>25</sup> McMahon, K & Dahdah, S. (undated). *The True Cost of Road Crashes: Valuing life and the cost of serious injury*. iRAP: Hamshire, UK. <http://www.irap.org/about-irap-3/research-and-technical-papers?download=45:the-true-cost-of-road-crashes-valuing-life-and-the-cost-of-a-serious-injury-espaol>.

Dahdah, S and Bose, D (2013). *Road Traffic Injuries: A Public Health Crisis in the Middle East and North Africa*. Transport Notes TRN-45. October 2013. World Bank, Washington DC. <http://siteresources.worldbank.org/INTTOPGLOOASAF/Resources/TN-MENA-Road-Safety-Dahdah-and-Bose-revised-print.pdf>

<sup>26</sup> Abegunde, D. & Stanciole, A. (2006). Estimation of the economic impact of chronic noncommunicable diseases in selected countries. World Health Organisation.

Abegunde, D., Mathers, CD, Adam, T, Ortegón, M., Strong C. (2007). The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet*, 370(9603), 1929-1938. doi: 10.1016/S0140-6736(07)61696-1

<sup>27</sup> Converted from US\$ taken from Source; <http://www.statista.com/statistics/263774/gross-domestic-product-gdp-per-capita-in-brazil/> June 2015

<sup>28</sup> McMahon, K & Dahdah, S. (undated). *The True Cost of Road Crashes: Valuing life and the cost of serious injury*. iRAP: Hamshire, UK. <http://www.irap.org/about-irap-3/research-and-technical-papers?download=45:the-true-cost-of-road-crashes-valuing-life-and-the-cost-of-a-serious-injury-espaol>.

<sup>29</sup> Converted from US\$ taken from Source; <http://www.statista.com/statistics/263774/gross-domestic-product-gdp-per-capita-in-brazil/> June 2015

### 3.5 CRIME VERSUS ROAD CRASHES IN BRAZIL

Traffic crashes kill more people in Latin America than crime and violence. Yet, the latter remain widely reported as the region's primary concern. However, it is noteworthy that for Brazil official figures suggest that homicide is more common than transport deaths. In official figures for 2012, 45,751 people died in traffic crashes versus 56,337 homicides. Clearly both are critical issues for Brazil to address. However, three aspects of the data suggest that traffic crashes may be more important as a cause of death. First, the official figure for traffic crashes may be underestimated. Second, traffic crash deaths are growing much more rapidly: from 2002 to 2012, road crash deaths grew from 33,288 to 46,581<sup>30</sup>: an increase of 38.3%, or even accounting for population increases over that decade, this increase remains 24.5%. Over the same period, homicides grew from 49,695 to 56,337, an increase, in absolute terms, of 13.4%, or accommodating population increases, 2.1%. Third, a major component of the suffering and hard economic cost of road crashes arises from the much larger number of serious injuries than deaths.

### 3.6 SUMMARY OF KEY FATAL AND INJURY CRASH FACTORS IN BRAZIL

The statistic fatalities per reported collision provides a guide to severity of crashes, as a guide to the types of collision on which Road Safety efforts should focus. Data for Brazil federal roads<sup>31</sup> identify that focus is warranted on the following crash types in particular: head-on, hit pedestrian, right angle collision, and run-off-road crashes (Figure 2).

#### ***Speeding***

Speeding is correctly recognized as the largest single behavioral contributor to road deaths globally, and this is also true of Brazil. Speeding is the key factor in road related trauma as identified in best quality research and reviews<sup>32</sup> including by world leading authorities: the World Health Organization, World Bank, and Global Road Safety Partnership<sup>33</sup> as well as the OECD<sup>34</sup>.

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<sup>30</sup> Data cited are from Preview of "Map of Violence 2014 youths of Brazil" Information System (SIM) of the Ministry of Health (MOH) 2014.

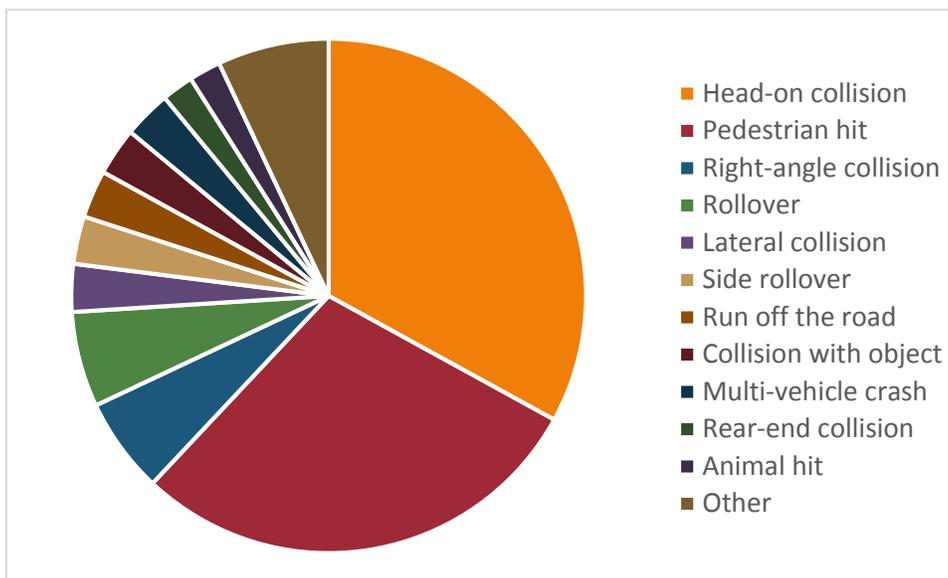
<sup>31</sup> Data from AANT, cited by Vasconcellos, EA Sivak, M. (2009). Road safety in Brazil: Challenges and opportunities. Report No. UMTRI-2009-29 August 2009

<sup>32</sup> Nilsson, G. 2004. Traffic Safety Dimension and the Power Model to describe the Effect of Speed on Safety, Lund Institute of Technology, Sweden.

<sup>33</sup> Global Road Safety Partnership (GRSP/WHO) 2008. Speed Management: A road Safety Manual for decision makers and practitioners. WHO/GRSP, 2008

<sup>34</sup> OECD (2006). Speed Management. Report of the Transport Research Centre, ECMT Paris.

**Figure 2. Proportion of road crash types on federal highways.**



Travel speeds commonly remain excessive, and are a key contributor to both crash occurrence and severity. Part of the reason for this is the high tolerance which is accepted above the speed limit before drivers are penalized for speeding, along with the low probability of being caught. Simply getting motorists to obey the speed limits would save many lives in Brazil.

In many cases, speed limits are also too high, set rather for traffic management purposes than for Road Safety ones.

### *Drink driving*

Driving with a blood alcohol level above the legal limit (drink driving) is undoubtedly one of the main factors contributing to deaths and injuries. In Brazil, drink-driving has improved but continues to be a major problem. Sound data on drink-driving in crashes do not appear to be available to monitor the issue. In addition, knowledge of the blood alcohol content limits and consequences is poor after the move to a zero BAC limit in Brazil<sup>35</sup>, but may have improved recently.

Deep-rooted legal/civil rights/constitutional challenges to the legal basis of drink-drive testing exist, though serious attempts to address this have occurred at a national level. Yet, improvement has been achieved, as can be seen from the numbers of people charged with drink-driving (including use of other substances, though the large majority of these offences are drink-driving).

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<sup>35</sup> Conceicao, T et al. (2012) Awareness of legal blood alcohol concentration limits among respondents for a national roadside survey for alcohol and traffic behaviors in Brazil. *International Journal of Drug Policy*, 23, 166-168.

### *Motorcycle Helmet Usage*

Motorcycle helmet use is the norm (though not uniform) in cities, but helmet use is less common in remote and rural areas. Failure of helmet use (or improper usage) is a significant contributor to Brazil's unsustainable motorcycle trauma problem.

### *Seat Belt Usage*

Seat belt usage rates remain low in Brazil in front seats and even lower in rear seats. Seat belt non-use is common (especially compared with the best performing countries which are reaching 99% usage rates).

### *Road Quality and Road Design*

Brazil contains the widest possible range of road quality and design safety (Figure 3), from extraordinary structures to weather dependent poor quality dirt roads, and from effective use of safety barriers to most unforgiving roadsides. The Federal, State and Municipal road networks are not designed as a safe system. Furthermore, there is no, or not yet, any strong movement in this direction in Brazil. A number of factors underlie this slow progress towards, including a continuing strongly victim-blaming culture, hindering concrete intervention on infrastructure (an also preventing enforcement).

**Figure 3. Examples of the range of roads in Brazil (examples from São Paulo and Bahia).**



## 4 FINDINGS OF THE MANAGEMENT CAPACITY REVIEW

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In this Section, findings of the Review are described in detail, along the several themes outlined in Section 2, *Review Description*.

### 4.1 LEAD AGENCY ROLE AND INSTITUTIONAL MANAGEMENT FUNCTIONS

#### *The Need for a Strong Lead Agency for Road Safety*

A sound Lead Agency for Road Safety is recognized internationally as critical to effective delivery of Road Safety improvement. As the 2013 World Bank Guidelines Update identified, the recommendation to create a Lead Agency “stresses the importance of institutional leadership which derives from a designated legal authority that has the power to make decisions, manage resources and coordinate the efforts of all participating sectors of government.”<sup>36</sup>

#### *The Situation in Brazil*

Brazil suffers from a clear absence of enshrined leadership of Road Safety, due to the absence of effective management structures for Road Safety and insufficient power assigned to Road Safety staff where they exist in core delivery organizations.

The absence of a Lead Agency stands out as a key omission in Brazil’s management of Road Safety. There is no single institution with appropriate functions, powers, funding, resources, staff and accountability to lead, manage, coordinate, facilitate, motivate, and monitor the disparate Road Safety activities of government agencies and others. This is true of the federal level and the state level in Road Safety management. Without systematic change, current Road Safety activities by other agencies are unlikely to produce strong Road Safety benefits for the resources invested.

Brazil is a federal country and the commitment of the Federal government is critical. In addition, many Road Safety activities are decentralized and thus leadership and commitment at both State and Municipal levels are also crucial. In Brazil, hundreds of organizations are involved in Road Safety, scattering accountability and effectiveness in dealing with Road Safety. They include:

- Many roads organizations managing roads, at federal, State and Municipal levels;
- Many relevant police forces: Federal, State and Municipal guards;
- Numerous organizations in addition to Police, varying across states as well as municipalities, manage speed cameras;
- Numerous organizations undertake education and promotional programs across Brazil;

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<sup>36</sup> Bliss A., Breen, J. (2013) Road Safety Management Capacity Reviews and Safe System Projects Guidelines- Updated Edition. Washington, DC: Global Road Safety Facility.

- Numerous organizations hold crash data or undertake research and evaluation of Road Safety;
- Numerous organizations inspect and register vehicles, and deliver driver licensing programs and testing (with relevant national standards);
- Some private sector organizations and NGOs advocate for Road Safety and promote to the community.

The absence of a Lead Agency stands out as a key factor in Brazil's management of Road Safety: strategies are not delivered by agencies of government and Road Safety is not effectively managed. Brazil has had a national Road Safety strategy for 2004-2014<sup>37</sup>, although it seems to have been little known and little used: no Road Safety stakeholder in Brasilia (or in previous reviews, in Rio Grande do Sul or Sao Paulo or Bahia) referred to it unless, explicitly asked by the World Bank team.

#### *Defining a Federal Lead Agency*

Road management agencies or police forces may be seen as lead agencies and may hold the accountability for Road Safety. However, these have multiple other accountabilities, are not sufficiently specialized and focused on Road Safety to be seen as clear lead agencies. The core feature of a Lead Agency is that Road Safety is a singular focus and reductions in road trauma (deaths and injuries) are its performance measures. (Key roles of the Lead Agency are noted in Box 1).

As a direct example of the importance of these roles the sound combination of enforcement and promotion of enforcement can double the safety benefits otherwise achieved with enforcement alone. In addition, an effective federal Road Safety Lead Agency (i) creates ownership of Road Safety as an issue; (ii) allows for a sound evidence-base for actions (which is currently not common in Brazil) and generates an evidence base which many stakeholders can use; (iii) creates a nationally strategic approach to Road Safety with associated genuine mechanisms for its delivery; (iv) is able to lead and advise on legislation and regulation; (v) advocates for Road Safety creating greater understanding of it in the community; (vi) generates efficiencies through reduced duplication of effort; and (vii) increases efficiency in the allocation of funding and resources for Road Safety to activities which are demonstrated to deliver Road Safety.

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<sup>37</sup> See targets sets for the strategy for 2004-2014, referenced in WHO (World Health Organization) (2013) *Global status report on road safety 2013: Supporting a decade of action*. WHO: Geneva.

### Box 1: The key roles of a Lead Agency

The first recommendation of the World Report to identify a Lead Agency within Government “stresses the importance of accountable institutional leadership which derives from a designated legal authority that confers the power to make decisions, manage resources and coordinate the efforts of all participating sectors of government.” From: World Bank Country Guidelines (Bliss & Breen, 2009).

The Lead Agency usually takes responsibility for:

- **coordination** within government, both horizontally and vertically at national, regional and local level;
- **coordination** of delivery partnerships between government partners and stakeholders, professional, non-governmental, business sectors and parliamentary groups and committees;
- ensuring a comprehensive **legislative framework**;
- securing sustainable sources of annual funding and creating a rational framework for **resource allocation**;
- high-level **promotion** of the road safety strategy across government and society;
- Regular and ongoing **monitoring and evaluation**, and reporting to Government.

In addition, enculturation of a Safe Systems approach is needed in Brazil (though advocacy for approaches with alignment to safe systems have occurred<sup>38</sup>), and this is unlikely to occur without a strong, resourced Lead Agency taking a genuine lead with understanding and ownership of Road Safety. Approaches to Road Safety at federal, state and municipal levels show a continued behavior focus to the exclusion of more systems orientated solution focused thinking on Road Safety.

#### *Mechanisms by which the Lead Agency may direct, guide, or influence the Road Safety activities of other organizations*

The Lead Agency would work with the high level Government committees required to ensure that recommended strategic collaborations and activities occur. Five broad options are considered feasible for the leadership and influencing mechanisms available to the Lead Agency (more detail is available if useful<sup>39</sup>):

- **Option 1:** The Lead Agency controls the budgets for Road Safety works of other agencies and distributes these by contractual arrangements or other legal tools that may be applicable for Road Safety related actions to be delivered.

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<sup>38</sup> Vasconcellos, EA. (1996). Reassessing traffic accidents in developing countries. *Transport Policy*. Vol. 2, No. 4. pp. 263-269.

<sup>39</sup> Job, RFS, and Czapski, R. (2014). Preliminary Consultation Note on Establishment of the National Road Safety Lead Agency for Poland. Warsaw: World Bank

- **Option 2:** The Lead Agency has only its own internal budget and exercises control over other agencies through sign-off approvals of the works they do. The limitation of this option is not being in control of how much effort or funding is spent on Road Safety, but the Lead Agency can force this to some extent in its approval conditions.
- **Option 3:** The Lead Agency has only its own internal budget and attempts to exercise control over other agencies through influence and input or negotiations on the works they do. The major limitation of this approach is that Road Safety is really dependent on the final decisions of other agencies which are not directly responsible or accountable for Road Safety but are accountable for other delivery elements (such as road condition for road agencies, and crime for police). Inevitably these other elements will dominate their decisions, as their core measures of success and failure. There is also a strong victim blaming culture encouraged by this model with Road Safety usually seen as someone else's responsibility.
- **Option 4:** Activity for Road Safety is forced by legal regulation or standards, so that the delivery of a Road Safety activity or product to a specified degree or standard is legally determined. The Lead Agency must control the standards and guidelines and monitor their delivery.
- **Option 5:** Mixed models of partial direct control of funding and partial approval process, partial standard setting, which are in reality mostly used by Lead Agencies, i.e. there are different types of Lead Agency relationships with different institutions.

The practical leadership models applied in different countries usually combine the above methods of control (i.e., **Option 5**). For example, in the State of New South Wales in Australia the Lead Agency directly held the budgets for Road Safety blackspot treatments but had sign off approval for all new road designs and building. A similarly mixed model of control and influence has been successful in Spain and elsewhere.

**Option 3** arrangements often fail. This is because the other agencies who are required to deliver their segments of Road Safety do not have Road Safety as their core objective, and thus will generally choose to spend their resources on the activities on which they are measured and held accountable. Thus, the Lead Agency is unlikely to have sufficient genuine influence. Sweden is the only country where this model has been successful; yet, Sweden's entrenched 'common good' culture makes it a special case.

## 4.2 RESULTS FOCUS AT THE SYSTEM LEVEL

### *The Need for a Results Focus*

Effective management of Road Safety requires a focus on results: when, where, how, why and to whom are serious crashes happening, for monitoring of outputs and outcomes of programs, refinement of programs, advocacy, and promotion. The critical role of a results focus for

successful management of Road Safety is recognized in the *World Report*<sup>40</sup> issued by the World Health Organization, as well as by the *World Bank Guidelines* which identify results focus as the pivotal institutional management focus.<sup>41</sup>

### *The Situation in Brazil*

*Goals for Road Safety.* In Brazil, many federal organizations, many States, and the large majority of Municipalities do not have a target for Road Safety improvement. Without a target, accountability and responsibility, monitoring, and a results focus will not occur. Sound management practices for Road Safety call for the setting of outcome targets (reductions in deaths and serious injuries), intermediate management targets (e.g., percentage of vehicle occupants wearing a seat-belt, motorcyclists wearing a helmet, and percentage of vehicles speeding) and output targets (e.g., amount of enforcement, speeding tickets issued, funds committed to improve roadside safety).

Yet, a positive sign of improving Road Safety results focus is that the target of a 50% decrease in fatalities by 2020, based on the target in the United Nations Global Plan for the Decade of Action for Road Safety<sup>42</sup>, has been identified as the working target by a number of Road Safety staff in municipalities as well as some states (e.g., by the State Committee for the Mobilization of Road Safety in Rio Grande do Sul, by the municipalities of Sao Paulo City, and Canoas in Rio Grande do Sul).

The absence of a comprehensive, complete national crash database, from which results can be monitored, is a profound impediment to setting and monitoring national targets, monitoring progress, effective advocacy, and building political and civil society ownership, conducive to the stronger political decision making required for substantial road safety improvement. Yet, some exceptional federal departments do have results focused management of road trauma for the components of the problem for which they are responsible (for example, Federal Police for federal roads and DNIT for speed management on federal roads).

Below the federal level, there is a broad, but not complete, absence of an evidence-based targeted approach and clear setting of priorities. States vary in results focus but are all hampered by crash data limitations. Small municipal governments demonstrate a clear absence of awareness of Road Safety, and allocate road maintenance and improvement resources on the basis of community expressions of concern rather than any evidence of Road Safety problems. Even when municipalities have access to crash data, there is often no long term management strategy, articulated plan or clear improvement target for Road Safety. This situation occurs, to a significant extent, in the larger municipalities as well. Municipalities are nonetheless critical to

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<sup>40</sup> Peden et al. (2004)

<sup>41</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C. page 11

<sup>42</sup> United Nations (2011). Global Plan for the Decade of Action on Road Safety 2011-2020. Geneva: WHO.

the delivery of Road Safety and the achievement of the target of a 50% reduction in fatalities by 2020 set in the Global Plan for the Decade of Action in Road Safety<sup>43</sup>.

Government agencies vary in the extent of their Road Safety focus. Certain teams within some agencies have a clear Road Safety focus (such as in road departments, Police, DETRAN, and key officers in some states and municipalities). The results focused efforts of the small number of enthusiastic expert staff and managers in roads agencies are limited to specific and narrow areas of delivery, such as treatment of some black spots on State roads only largely through 'lines and signs', which are too often misperceived as the key tools of Road Safety engineering. Despite cautiously positive commentaries from many people interviewed, it is apparent that limited legal responsibilities and powers, lack of coordination of emergency responses to serious crashes, lack of real power in Road Safety departments which are significantly marginalized, and lack of significant sustainable funding, have all substantially limited the abilities of these organizations to deliver Road Safety and sustain a results focus in the face of disempowerment.

Crash database issues. Of all the crash data collection and storage systems in Brazil, no one meets the core criteria required of such a system to provide a full and effective data source on crashes to guide and monitor Road Safety performance. The best official national coverage comes from DataSUS while the Federal Highway Police data and state police systems contain superior detail of the crashes partially allowing identification of interventions for federal and state roads. Thus, a full results focus for broad management and monitoring of Road Safety is not possible at the national level. Improving Road Safety by targeting Road Safety interventions accurately and monitoring results, require a sound crash database and ultimately a comprehensive Road Safety observatory.

Collaboration and coordination of agencies with databases to produce the required single combined police based crash database covering the country is needed. There is a varying degree of results focus across the federal governments departments, and the states, though the state agencies focus on state roads only. While this remains of value for the states' management of engineering and state police enforcement on state roads, this does not create a collaborative focus, or allow a broader picture of the problem for advocacy, coordination or broader education and enforcement purposes at federal or state levels. Attempts to improve coordination of data and other aspects of Road Safety management are occurring at the municipal level through the RS10 project in 5 cities and a pilot project to link the databases in the 26 Capitals, Federal District and 2 Cities, though crosschecking of data from SAMU, Fire Department, Federal Highway Police, State Highway Police and Municipal Guards.

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<sup>43</sup> United Nations (2011). Global Plan for the Decade of Action on Road Safety 2011-2020. Geneva: WHO.

### 4.3 COORDINATION

#### *The need for multi-sectoral and across State Government Agency Coordination and Collaboration*

Coordination is recognized as a key management function for Road Safety, including multi-sectoral coordination amongst and within governments (national, state, and municipal), non-government stakeholders, and parliaments.<sup>44</sup>

#### *The Situation in Brazil*

Within Brazil, the contributions of the three levels of Government, each with their own roads, will require significant coordination in order to ensure consistency of crash data, consistency with national strategies, messaging and approaches, and in order to capture synergies of actions where they are available. The absence of clear leadership from a central Lead Agency has led to limited partnership development amongst agencies and absence of development of multi-sectoral action plans and effective sharing of learnings across municipalities and across states. Consensus on Road Safety directions and collaboration has not been effectively built. Sectors and departments do not effectively mutually reinforce each other's Road Safety activities.

Yet, there is some important coordination horizontally from the national level and across some State governments in Road Safety, including:

- CONTRAN (national committee consisting of the following representatives: Presidente – Diretor do DENATRAN, *Ministério da Justiça, Ministério da Defesa, Ministério dos Transportes, Ministério da Educação, Ministério da Saúde, Ministério da Ciência, Tecnologia e Inovação, Ministério do Meio Ambiente, Ministério das Cidades, Ministério do Desenvolvimento, Indústria e Comércio Exterior, Agência Nacional de Transportes Terrestres*) assists with coordination on traffic matters at the national level;
- Committees designed to assist with coordination also exist in some states. In Rio Grande do Sul, the State Committee for Mobilization for Road Safety is attempting to improve collaboration by engaging many stakeholders and informing each other of Road Safety activities. An important strength of the Committee is that it is chaired by the Vice Governor. However, the Committee is too large to be effective: with over 70 members it operates more as a means of dissemination (which is useful) rather than decision making and coordination;
- Police sourced crash data being effectively used by the state road agencies for crash blackspot identification and treatment;
- Road agencies and departments of planning work collaboratively.

At both federal and state levels, Road Safety programs exist and Road Safety activity occurs. However, the lack of coordination and leadership means that such programs are less efficient

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<sup>44</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C.

and effective than they could be with well-developed co-operation. Work is fragmented in several ways; for example, there appears to be little accountability for pedestrian safety in large cities, in small cities, on highways, or on rural roads.

The extent of vertical co-ordination at the National-State level is also concerning for Road Safety. For example, there is little coordination and national uniformity in Road Safety policy and practice between federal and state governments. While the federal government sets road law and minimum standards on various aspects of road transport, the coordination required to produce a singular police recorded crash database or a tight singular licensing system has not yet been developed.

### *The specific situation of Municipal Governments*

Municipalities are key in Road Safety management and their activities need coordination with the other levels of government. Municipalities are the road authority for the large majority of roads in Brazil, as in most states and countries; globally, it is common to find that a majority of road deaths occur on Municipal (local government) roads. Internationally, increased ownership of Road Safety has been effective in improving Road Safety on municipal roads (e.g., in New Zealand) and efforts to increase the Road Safety activities of municipalities have been effective in many instances. For example, the Center for Road Safety in New South Wales Australia successfully joint funded local councils to undertake Road Safety projects and local councils around Australia are able to apply for funding from the Federal and State Governments to fix serious crash locations on their roads.

In Brazil, the majority of the 1.6 million km of roads is managed by the municipalities (estimated at about 1.3 million km, with only a fraction paved)<sup>45</sup>. With responsibility for the large majority of the network (77%, though of course a lower percentage of the vehicle kilometers), an effective role by the municipalities in Road Safety in Brazil is a critical success factor. As part of the ongoing limitations of crash data in Brazil, sound data on the percentages of deaths on each road network are not available. However, data for federal roads are available and indicate that for 2013 of the official 42,266 deaths, 6,874 were on federal roads, leaving 35,392 deaths (83.7%) on state and municipal roads.

Brazil has an excessive number of municipalities, for them to be effective for Road Safety. Tiny municipalities are not only unable to provide municipalized traffic, but are insufficiently resourced and funded to manage the basic safety of their road networks though analyzing crash data, identifying blackspots, and improving roads. Thus, the number and size of the smaller municipalities presents a significant impediment to Road Safety on local roads in Brazil.

Table 4 presents the number and percentage of municipalities without municipalized traffic by state. While significant percentages of municipalities without municipalized traffic in some states reflect a reliance on water based transport (e.g., in Amazonia), the high percentages in many

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<sup>45</sup> From DNIT's website, March 2015.

other states are deeply concerning. No state has a majority of municipalities with municipalized traffic, with even Sao Paulo in a minority at 43.3%. Although, the 1,438 with municipalized traffic represent 72% of the population and 82% of the national fleet.. A number of large municipalities are making serious attempts to manage Road Safety (for example Porto Alegre and Sao Paulo have strong municipal guard organization, many speed cameras, and blackspot programs). As an example of the level of traffic enforcement and activity for a strong performing medium size municipality, the Box below presents details from the municipality of Formosa in Goiás.

**Table 4. Number and percentage of municipalities with municipalized traffic by State.**

State	Number of Municipalities with Municipalized Traffic*	Total Number of Municipalities**	%
Acre	1	22	4.5%
Alagoas	13	102	12.7%
Amapá	3	16	12.8%
Amazonas	10	62	16.1%
Bahia	51	417	12.2%
Ceará	57	184	31.0%
Distrito Federal	1	1	100%
Espirito Santo	7	78	9.0%
Goiás	36	246	14.6%
Maranhão	52	217	24%
Mato Grosso	23	139	16.5%
Mato Grosso do Sul	47	77	6.1%
Minas Gerais	53	853	6.2%
Pará	51	143	35.7%
Paraíba	23	223	10.3%
Paraná	40	399	10.0%
Pernambuco	28	185	15.1%
Piauí	11	222	4.95%
Rio de Janeiro	65	92	70.6%
Rio Grande do Norte	16	167	9.6%
Rio Grande do Sul	459	497	92.4%
Rondônia	6	52	11.5%
Roraima	1	15	6.7%
Santa Catarina	81	293	27.6%
São Paulo	279	645	43.3%
Sergipe	18	75	24.0%
Tocantins	6	139	4.3%
<b>TOTAL for Brazil</b>	<b>1,438</b>	<b>5,561</b>	<b>25.8%</b>

## 4.4 LEGISLATION

### *The Need for Legislation*

Relevant agencies must aim to ensure that laws and regulations are appropriate and effective for the Road Safety circumstances of the jurisdiction. It is recognized by the World Bank as a key Road Safety management capacity.<sup>46</sup>

### *The Situation in Brazil*

The current legislative and regulatory framework for Road Safety would require several improvements to match current needs. While some penalties have been appropriately increased recently, many penalties have not increased to keep pace with inflation or the overall increasing wealth of Brazil. They are now too low to act as an effective deterrent for many people. Effective enforcement of drink-driving remains a challenge despite recent improved National legislation (because drivers can still refuse the breath test and thus require the Police to establish via witnesses that the driver is impaired by alcohol), and the responsibilities of the various agencies involved in Road Safety are not clearly articulated or are not followed, and local government appears to be able to avoid accountability. Legislative regulation could address this.

Other problems with current practice in relation to on-road enforcement relate to the processing and management of penalties. Offenders are able to delay paying fines for long periods with little consequence. First, there is an excess of opportunity to challenge the penalty, with the first point of challenge being free even if rejected. Second, if the fine is not paid quickly (which appropriately results in a discount) then the offender can wait up to a year before paying and pay when their driver's license or vehicle license is due. Finally, by selling the vehicle (or otherwise disposing of it rather than re-registering it) the fines may be avoided altogether. This situation is well recognized by motorists and results in profound damage to the essential deterring effects of enforcement in Brazil, because the penalty is seen as at least greatly delayed or entirely avoidable. Furthermore, even vehicle impoundment processes designed to address this problem (if a vehicle is detected with fines overdue) are not working effectively (see Box 2 on Road Safety activities of Formosa as an example). Annex 7 provides a detailed analysis of the legal situation related to Road Safety in Brazil.

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<sup>46</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C.

### **Box 2: Traffic related activities by Formosa municipality**

Formosa is a municipality of 110,000 people in Goiás, and is actively moving to further manage traffic having started municipalized traffic only recently. Municipal guards are authorized to enforce traffic only by arrangement with DETRAN and the State Military Police. 48 of the 260 municipal guards had been trained to undertake traffic enforcement, at the time of our visit in early 2015. Only around 30% of those fined for traffic offences pay in the initial period. Enforcement includes active checking of vehicle registration because this reduces fine avoidance. Unregistered vehicles (usually because of outstanding fines) are supposedly impounded by State Military police. However, often this does not occur because available vehicle storage is filled. Formosa is planning to provide more vehicle storage for this activity but it had not occurred at the time of writing.

Formosa records crash details, except if the crash is fatal in which case State Military Police are called. There is duplication of crash data with Formosa holding two crash databases (the municipality's own database and the DETRAN database); Formosa's crash data are recorded into the DETRAN system of Goiás as well as their own system, and the data are also collected by Federal Police and State Military Police.

There is also duplication of enforcement records and processes, with Formosa recording infringements in their own data system as well as into DETRAN's system in order to have penalty points on licenses activated. Fines are paid to DETRAN, which pays part of the money back to Formosa.

Formosa reports that they issue around 20 infringements per day. This is a low rate relative to having 48 Municipal Guards able to issue tickets. Even allowing for days off, this amounts to well under 1 ticket per day per guard. There is also duplication of organizations to issue tickets: DETRAN at the state level and CITRAN at the municipal level.

*Formosa does not have a plan or a target for road safety.*

The three levels of government (national, state and local) do not co-ordinate extensively on Road Safety legislation, which is set nationally. In addition, Road Safety considerations are at times over-ridden by non-Road Safety considerations such as political expediency and productivity (sometimes misperceived as being increased by higher speeds). Examples include allowing higher mass limits for heavy vehicles, legislated requirements for warning signs at speed camera locations (see below), and legislated tolerances of 7% on speed enforcement (rising to 10 at

100km/h), despite the evidence for a clear and substantial role of low level speeding in road deaths and injuries<sup>47 48</sup>.

Brazilian federal law dictates that fixed speed cameras must be preceded by a warning sign. This requirement adversely impacts Road Safety: a mix of overt and covert cameras has been proven to provide better crash and casualty reductions than overt cameras alone<sup>49</sup>. With appropriate communications and awareness, the flexibility to provide general warning signage but not signage explicitly prior to all fixed cameras may encourage broader suppression of speeding, rather than motorists slowing down only at speed camera sites. Although fixed cameras as treatments for crash locations are appropriate, enforcement must also suppress speeding more broadly across the road network.

Vital interest in Road Safety exists among a few members of the Federal parliament. However, there appears to be no parliamentary committee on Road Safety in the federal parliament or most state parliaments. Ideally, such committees would have goals to strengthen the development of the Road Safety legislative framework, increase public awareness of Road Safety and the role of government in Road Safety, and hold investigations on specific Road Safety issues resulting in evidence-based recommendations for policy and/or legislative change. Committees of this form work effectively for Road Safety in other countries.

#### 4.5 FUNDING AND RESOURCE ALLOCATION

##### *The Need for Appropriate Funding and Resource Allocation*

Sufficient funding and sound evidence-based resource allocation are critical to Road Safety management. Institutional management should ensure these on a sustainable basis for Road Safety.<sup>50</sup>

Delivery of Road Safety will require sufficient resources genuinely committed to Road Safety for the new Lead Agency, federal and state government agencies, and local governments to make Road Safety a reality for the people of Brazil. It also requires that the resourcing and funds are allocated to Road Safety measures which genuinely address Road Safety not actions which seem

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<sup>47</sup> Gavin, A., Walker, E., Murdock, C., Graham, A., Fernandes, R., Job, R.F.S. (2010). Is a focus on low level speeding justified? Objective determination of the relative contributions of low and high level speeding to the road toll. *Proceedings of 2010 Australasian Road Safety Research, Policing and Education Conference, Canberra, September 2010*. Canberra: Commonwealth Department of Transport and Infrastructure.

<sup>48</sup> Nilsson, G. 2004. Traffic Safety Dimension and the Power Model to describe the Effect of Speed on Safety, Lund Institute of Technology, Sweden.

<sup>49</sup> Keall, MD., Povey, LJ. & Frith, WJ. (2001) The relative effectiveness of a hidden versus a visible speed camera programme. *Accident Analysis & Prevention, 33, Issue 2*, 1 March 2001, Pages 277–284

<sup>50</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C.

popular and thus politically convenient or activities which assist other deliverables but do not genuinely deliver Road Safety (e.g. improving road surfaces).

### *The Situation in Brazil*

Road Safety funding at all levels of government is uncertain. In federal and state governments, typically Road Safety is funded from the consolidated funds to road and other agencies, though an amount is not specifically allocated to Road Safety by government. The actual spend on Road Safety is determined by internal budgetary arrangements within agencies. Investment in Road Safety is not sustainably regulated and does not appear to be commensurate with the size of the problem and its attendant economic, human and social costs. According to the Traffic Code (CTB – *Código de Trânsito Brasileiro* – Law nº 9.503, of September 23, 1997, in Article 320) funds from speed cameras must be spent on signals, traffic engineering, enforcement and education. However, most of the money being spent on signals and traffic engineering for traffic flow is not Road Safety. Examination of various states and municipal expenditures of these funds show quite small percentage of funds (<10%) is actually for Road Safety.

The Federal Government benefits substantially from the compulsory third party insurance, which is run by *Seguradora Lider DPVAT*, for a consortium of insurance companies. Half the funds provided to government are distributed to the federal government consolidated revenue, with 45% to *Sistema de Saude* and 5% to DENATRAN. From 2004 to 2012 this amounted to about BRL17,939 million to *Sistema de Saude* and BRL1,993million to DENATRAN. These funds could be committed to Road Safety, by either fully expending them on genuine Road Safety engineering works on the federal road network, and/or through distribution of funds by federal Government to the States or local councils, with specifications, accountability and monitoring, of the expenditure of the funds on Road Safety works.

Other potential (but currently not allocated to Road Safety) sources of funds for Road Safety include:

- IPVA (Imposto sobre a Propriedade de Veículos Automotores, a vehicle tax) collected by the State, and;
- Licenciamento (Licenciamento do Departamento Estadual de Trânsito - DETRAN).

Local government investment in Road Safety varies with their size, but is generally inadequate (though specific figures are not available). While the commitment of some cities is significant, it is not commensurate with the inhabitants and the magnitude of the Road Safety problem of the city. Small cities have little awareness of the problem and do not appear to allocate funding specifically to Road Safety, but rather determine relevant roads works through local concerns rather than an evidence based approach, with the hope that the works will do some Road Safety good anyway. As mentioned earlier, the critical role of speed enforcement, which local councils can undertake via cameras, is often not adopted because of concerns with negative views from

voters. This also means an important source of revenue for Road Safety works, as well as direct Road Safety gain, is not accessed.

## 4.6 PROMOTION AND EDUCATION

### *The Need for Promotion and Education on Road Safety*

Promotion (sustained, effective, content and tone appropriate) is a key Road Safety management capacity for government and nongovernment stakeholders. Promotion is more than Road Safety advertising. It should address the overall level of ambition of society and government in Road Safety.<sup>51</sup>

Education in Road Safety is important to Road Safety. In certain circumstances it works, though it is over-used. There is a great deal of community faith in education and the Lead Agency needs not coordinate it effectively with the Department of Education and others. Done badly, Road Safety education can be harmful and expert involvement is essential.

### *The Situation in Brazil*

Promotion is needed on two critical fronts in Brazil. First, a systematic communication strategy is needed to promote Road Safety and to increase awareness of risk and improve on-road behavior. Second, pressure from the population to reduce the high level of crash risk and demand for Road Safety improvement by government are rare in Brazil but of great value for political ownership of Road Safety. The problem is not a lack of concern with Road Safety by the people, but rather a view that deaths and injuries are the fault of the individuals involved, and Road Safety is not seen as a key shared responsibility of government as well as road users. Thus, Road Safety is often not seen by Governments as being their concern because they do not believe that the community sees Road Safety as being a responsibility of government.

Promotion in Brazil is generally not focused in a coordinated or strategic fashion: it lacks set outcome targets, planned sequencing, and close connection to relevant actions as anchors for behavior change or for attitude change to allow and push for more effective engineering actions from government. It is almost entirely behaviorally focused (see Figure 5a below, as an example of the behavioral focus). Figure 5b is however, an example of a reasonable behavior change program which follows some core psychological principles: it is focused on enforcement rather than as severe crashes basis for behavior change, which mitigates the psychological barriers of optimism bias and driver over-confidence (a number of sources<sup>52</sup> are available for a brief account

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<sup>51</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C. page 12

Job, RFS (1990). The application of learning theory to driving confidence: The effect of age and the impact of random breath testing. *Accident Analysis and Prevention*, 22, 97-107.

of relevant psychological principles and the evidence for the value Road Safety advertising and of enforcement based messages in particular to motivate behavior change).

Figure 5a and 5b: Two examples of national Road Safety campaigns



Promotion by NGOs: Promotion of the need for Government action in Road Safety is normally a critical role of NGOs and academic researchers. However, this is not occurring in any systematic effective way in Brazil. While Road Safety advocacy pushing governments to do more at a publically visible level is rare, there is some Road Safety advocacy by NGOs. NGO efforts could be better focused promoting the responsibility of governments (as well as road users) in addressing the road toll. This education of the community may help to raise political ownership, accountability, and motivation for Road Safety. This is sometimes occurring (e.g., and the National Observatory's promotion of the road deaths and injuries as an issue and the importance of Road Safety).

Such promotion and education by media and NGOs must be for sound evidence-based actions, and ideally the reporting of crashes should not focus on victim blaming and a strongly behavioral

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Dalziel, J.R. & Job, R.F.S (1997). Motor vehicle accidents, fatigue, and optimism bias in taxi drivers. *Accident Analysis and Prevention*, 29, 489-494.

Jonah, B. A. (1986). Accident risk and risk-taking behaviour among young drivers. *Accident Analysis and Prevention*, 18, 255-271.

focus, as currently occurs. The second promotional role of NGOs, to improve the behavior of road users is occurring (e.g., ABRAMET's work on the importance of speed), though it is not systematic and rarely high profile. Finally, some NGOs do work directly with government to improve legislation and regulation (for example, Kidsafe has worked effectively with the National government on regulation of child restraint use for children up to the age of seven and a half years).

Open and user friendly public (and especially media) access to crash data will also facilitate advocacy, public awareness and understanding of Road Safety, and Government accountability. In the respect, while the data are imperfect, at the national level they are made available via Federal Government departments and though their provision of the data to the National Observatory. Such access to data is much less common at the state level and almost non-existent at the municipal level.

School based education. In addition to educational and promotional campaigns for children by State Military Road Police in a number of states, Road Safety education is mandated by national policy to be a core element of school education. The Ministry of Education also provides materials for Road Safety education. However, typically there is no structured systematic state wide age-appropriate Road Safety education program in schools. States generally do not take ownership of Road Safety education and report that the curriculum is too full to fit it or they include a small amount of Road Safety in broader school safety and security content which is largely aimed at bullying. This is inadequate to address the most likely cause of death for school age children - road crashes.

Oddly, in combination with little systematic Road Safety education in schools there is also too much faith (among the community and in many Road Safety circles) in education (including training) alone as a means of solving Road Safety problems. This unusual combination leaves many Road Safety stakeholders feeling demotivated that they can do little because sound education is the answer but it is not provided. For example and counter-intuitively, more driver car handling skills training, advanced driver training, defensive driver training and driver training in schools all fail to deliver the expected Road Safety benefits, or indeed any Road Safety benefits, but rather show a tendency to result in increased crashes<sup>53 54</sup>. A likely explanation of this finding is that increased training results in great over-confidence and thus risk taking<sup>55</sup>.

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<sup>53</sup> Roberts IG & Kwan I (2008). School-based driver education for the prevention of traffic crashes (Review). Cochrane Library (Wiley).

<sup>54</sup> Kardamanidis K, Martiniuk A, Ivers RQ, Stevenson MR, Thistlethwaite K (2010). Motorcycle rider training for the prevention of road traffic crashes (Review). *The Cochrane Library* 2010, Issue 10.

<sup>55</sup> Job, RFS (1996). Driver training: Are we looking in the right place? C. Grigg (Ed.), *Proceedings of the 6th Biennial Australian Traffic Education Conference*. (pp.140-143). Armidale, NSW: EMU press.

## 4.7 MONITORING AND EVALUATION

### *The need for monitoring and evaluation*

Monitoring and evaluation (the systematic ongoing measurement of Road Safety inputs, outputs and outcomes) is another key management function<sup>56</sup>, without which management is blind to the effects of Road Safety actions.

### *The Situation in Brazil*

Monitoring and evaluation of Road Safety programs are rare, as are published report and scientific papers offering evaluations. There is little support for evaluation so that Road Safety interventions are often implemented without clear analysis of the “before” situation or systematic collection of “after” data for evaluation: sub-optimal schemes may be repeated and scarce resources wasted.

The absence of a national unified single detailed crash database, or single unified databases for each state is a profound impediment to effective Road Safety management, responsibility, accountability, monitoring and evaluation. This in turn limits monitoring, evaluation, and properly informed future investment decisions.

The crash database held by Police is, as with almost all such databases, focused on the behavioral contributors to crashes, and has little systematic information relevant to the other elements of safe systems. For example, the focus is on the cause of the crash not the causes of injuries, and to the extent that any road factors are identified these are considered as contributors to the crash occurring rather than contributors to the injury or lack of injury (e.g., a wire rope barrier struck by a vehicle rather than a tree). Brazil is not alone in having this problem, and indeed the legal and behavioral focus of police work renders such a focus axiomatic. Some countries have addressed this through detailed linkages of the crash data with road feature databases<sup>57</sup>, and hospital databases which reveal associations between crashes, roadside furniture (barriers, poles, etc.) and injury outcomes.

Police crash data do not appear to be linked to health data and thus it is not possible to assess the health costs of crashes based on features of the crash (crash type: head on versus pedestrian, etc.; speed limit, vehicle type, etc.). A sound connection between crash and hospital data would also allow stronger assessment of crash costs overall and by type, location, speed limit, etc. allowing more precise evaluation of Road Safety programs and more precise selection of works for stronger benefits.

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<sup>56</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C.

<sup>57</sup> Levett, S. Saffron, D., Tang, J. & Job, R.F.S, (2008). What factors actually affect crash severity and how can road safety programs be better targeted? In R. Anderson (Ed.) *Proceedings of the 2008 Australasian Road Safety Research Policing Education Conference, Adelaide, November. PP848-857.*

Improved crash data and their use for evaluation need to be supplemented by a focus on intermediate outcome data which tell a story about the problems, advantages, and impacts of programs, which otherwise remain invisible. Possible examples include: on road observations of seat belt wearing rates, helmet use, tracking of driver attitudes and beliefs, and travel speeds. In addition to monitoring of final and intermediate outcomes, systems need to be established to ensure that monitoring and evaluation are integral part of safety programs at all levels of government. Direct monitoring of the delivery of Road Safety programs does sometimes occur (levels of infringements, engineering changes to roads). Evaluation and monitoring should be planned and costed into programs from the start.

*Social costs:* Estimates of the socio-economic costs of road traffic crashes in Brazil were last undertaken in 2006, and were updated in 2015. This joint evaluation between IPEA and Federal Highway Police estimate the social cost of traffic accidents in BRL \$40 billion per year. Despite methods available for the estimation of costs of road trauma in Brazil<sup>58</sup>, there is a broad lack of appreciation of the real economic costs of road crashes and trauma. Socio-economic costs of road fatalities and injuries are not employed to present the business case for Road Safety investment, to prioritize works, or to seek greater funding priority for Road Safety. In the absence of these data, some road authorities sometimes employ weighted rates of injury and death to prioritize works. While this is not ideal, it is a reasonable approach in the absence of costing data, but such uses are rare and do not address the remaining uses of such data for business cases for Road Safety or the promotion of Road Safety as an economically viable investment.

#### 4.8 RESEARCH AND DEVELOPMENT AND KNOWLEDGE TRANSFER

##### *The value of research and development and knowledge transfer*

Well research evidence based Road Safety decisions are critical to success and to avoiding well-meaning or politically easy but ineffective solutions. Research, development and knowledge transfer improve the efficiency and effectiveness of Road Safety management, making them key management functions.<sup>59</sup>

##### *The Situation in Brazil*

Brazil is able to undertake its own research to develop solutions for Road Safety, but should also rely on the identification of solutions from elsewhere. Most aspects of Road Safety (the laws of physics, the operation of roadside barriers, roundabouts, signals, road design, vehicle safety ratings) apply from one country to another. Social values and attitudes vary. Caution should be exercised to avoid unnecessary duplication of research from other countries and states, when

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<sup>58</sup> IPEA/ANTP. (2006).

<sup>59</sup> Bliss, A. & Breen, J (2009). Country guidelines for the conduct of road safety capacity reviews and the specific of lead agency reforms, investment strategies and safe system projects. World Bank Global Road Safety Facility, Washington, D.C.

often it is clear that the recommended course of action will be effective in Brazil. Research should include scanning for such programs from elsewhere.

In addition to the usual formal training processes for the relevant professions, knowledge transfer processes are undertaken, including training of Road Safety staff in statistics and crash data, and training of Police for crash data recording processes. More comprehensive training in Road Safety would be of value at federal, state and municipal levels.

With just one or two notable exceptions, the lack of Universities and academics working strongly on Road Safety at the national level in Brazil limits effective research and development, as well as provision of sound Road Safety training. There appears to be an inadequately small, community of research experts in Road Safety in Brazil. Road Safety managers interested in establishing collaborations with researchers struggle to find available interested researchers despite the useful research opportunities these collaborations offer. Human capacity must be improved in this area, and will be needed within the lead agency as well as for the continuing role of independent experts is also critical.

Knowledge of Road Safety programs, their effectiveness and management exists in too few staff in Government. Significant knowledge development and transfer is required for Road Safety management, monitoring, and selection of the most effective Road Safety strategies and projects, as well as for evaluation and refinement.

While there is good understanding among some public sector staff working on Road Safety, among most government officials there is a lack of understanding of Road Safety, and especially of safe systems. There is an unwarranted focus on behavior change rather than all the elements of the road transport system, as emphasized by the safe system approach. Ability to deliver Road Safety improvements is made more difficult by the lack of appreciation of, and application of, safe systems principles.

#### **4.9 CAPACITY TO DELIVER RESULTS OVER THE ELEMENTS OF THE SYSTEM TO BE MANAGED**

##### *Planning, design, maintenance and operation and use of the road network.*

Engineering roads for safety is a fundamental pillar of the safe systems approach, and an essential mechanism by which the most successful Road Safety countries in the world have dramatically reduced deaths and injuries on their roads. The first priority focus must be on preventing death or serious injury in the event of an error, not on assisting the driver not to make an error.

Knowledge transfer is called for to address this situation, including safe systems training, engendering an understanding of the roles of all the pillars of safety (safe roads, safe vehicles, safe speeds, and safe people, combined with sound management), and an appreciation that safe systems can inform Road Safety expenditure even when the funds are limited.

Opportunities for improved safety are considered below, divided into three broad categories (1) *road design and building*, (2) *maintenance and operation*, and in (3) *changes in design building maintenance and operation to accommodate motorcycles*.

Many opportunities exist for improved road and roadsides for safety of users (Figure 6). The lists below are focused on the particular and most prominent problems identified on the roads of Brazil. These have been chosen based on extensive review of Federal, State, and Municipal roads in many states and on the crash data which identify particular problems which yield major opportunities for improvement. The serious crash data (as reviewed earlier in this report) in particular identify the critical need to address the following issues, which are amenable to changes in road design, building, maintenance and operation:

- Motorcycles are the largest single contributor to road trauma, and must be a point of focus;
- Pedestrians are a significant group of victims of road crashes;
- On rural roads, head-on crashes and crashes off road (including roll-over) are major crash types contributing to deaths and serious injuries;
- Intersections are a key serious crash risk location, with high rates of death for right angle crashes especially.

**Figure 6. Examples of unsafe end treatments on barriers, on highways in various states.**



#### ***Management of vehicles on the road network***

Safer vehicles (which protect occupants in the event of a crash, and which reduce the risk of crashes through various active technologies, such as electronic stability control) can save many lives and debilitating injuries in Brazil. Vehicles with better crash protection save both lives and serious injuries. Only in select circles is there an appreciation of the value of safer vehicles for Brazil's road trauma problems.

On this regard, opportunities come from i) better regulation for vehicle safety standards, ii) review policies on pricing of older vehicles and, iii) better enforcement of vehicle standards and owner responsibility.

#### *Management of road users on the road network*

Many critical processes and behavioral issues are identifiable from on-road observations in Brazil (especially remote and rural areas) and from the crash data and research evidence. A list of these (with each presenting opportunities for improved safety) is provided below. These behavioral issues are underpinned by a number of key behavior change management limitations in Brazil.

**Specific Deterrence** is the extent to which a person is deterred from doing a certain action (such as speeding, running a red light) because they have been caught and penalized for that behavior. The more people who are caught, the more people who are affected by specific deterrence. The effects of specific deterrence are enhanced by the threat of increasing penalties for repeat offences. Therefore, getting caught can increase deterrence because the penalties for getting caught again will be more severe. For example, many penalties increase for repeat offences (such as drink-driving), and the demerit points scheme makes the threat of license loss more possible with any offence carrying points.

**General Deterrence** is extent to which people are deterred from doing a certain action, not because they have been caught, but because they believe they may be caught and the consequences of being caught are undesirable. Thus, people avoid the behavior in the first place, and this is a key benefit to Road Safety. Successful punishment avoidance experiences greatly damage both specific and general deterrence. Specific deterrence is damaged because the successful avoider is not caught, and general deterrence is damaged by the belief that enforcement can be avoided with the same tactics in the future. The effect can spread by the avoider telling others how to do it. Rumors and/or beliefs that avoidance is possible can harm general deterrence regardless of how correct they are. These must be managed through strong enforcement practice which minimizes avoidance combined with communications to the community and the media showing how enforcement practice is overcoming avoidance behaviors.

#### *Management of travel speeds on the road network*

In official figures speeding is generally underestimated as a factor in fatal and serious crashes. This claimed under-estimation in official figures is demonstrated by the effects of speed cameras in other countries. For example, official estimates (based on Police reports) indicated that speeding contributed to around 35 to 40% of fatal crashes in the state of New South Wales (NSW, the most populous state of Australia), yet the independent evaluation of the NSW fixed speed cameras revealed that at treated locations, the cameras resulted in a 71% reduction in speeding and an 89% reduction in fatalities<sup>60</sup>. Because speed cameras only address speeding as a crash

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<sup>60</sup> Job, RFS. (2012). Applications of Safe System Principles in Australia. *Paper to the 2012 Australasian Road Safety Research, Policing and Education Conference, Wellington, New Zealand, October.*

factor, these results suggest that speeding was contributing to most fatalities (at least 89%) not merely 35 to 40%. Evaluations of point-to-point (or section control) cameras in Europe has revealed similarly dramatic reductions in serious crashes when speeding is managed.

**Figure 7. Extensive speed camera warning signs on urban and open roads in Brazil.**



Following the observation of cases of excessive speeding by the World Bank assessment team, a small on-road objective speed survey was conducted for the World Bank team by State Military Road Police. The study was undertaken in daylight on rural Highways BA262 and BA263 to check speeding. The speed surveys confirmed a serious speeding problem on both highways: In the two locations on 80km/h zones excessive speeds were common: for one of these locations the average speed of identified vehicles was 98km/h (18km/h above the limit). In 40km/h zones, many instances of speeds over 70km/h were observed. Such speeds are major contributors to crash occurrence and severity, and cannot be allowed to continue. The success of speed cameras in reducing road deaths and serious injuries is irrefutable. Numerous studies have been reviewed by the OECD<sup>61</sup>, and by the Cochrane Library Review,<sup>62</sup> both concluding that the evidence shows that speed cameras clearly provide substantial Road Safety gains in terms of reduced deaths and injuries. These are dramatic improvements via relatively inexpensive treatments.

Speed limits in Brazil are also too high for the road usage occurring in many instances and should be reviewed. Although speed limits on rural roads are generally either appropriate or not far from appropriate for the environments in which they exist (with a few exceptions), travel speeds commonly remain excessive, and are a key contributor to both crash occurrence and severity.

Finally, it is important to employ road engineering treatments for speed management and to retain existing treatments such as speed humps and cobblestones which reduce traffic speeds.

<sup>61</sup> OECD. (2006) *Speed Management. Report of the Transport Research Centre*, ECMT Paris.

<sup>62</sup> Wilson C, Willis C, Hendrikz JK, Le Brocque R, Bellamy N. 2010. *Speed cameras for the prevention of road traffic injuries and deaths*. Cochrane Database of Systematic Reviews, Issue 11

This can include transverse rumble strips, speed humps which should be used more as an effective treatment, gateway treatments, and other devices. There is little results focus on speeding in Road Safety management, with no apparent intermediate outcome measures in use for monitoring.

#### *Recovery and rehabilitation of crash victims from the road network*

Emergency services and health care are provided to a generally sound level, through SAMU (Ambulance), fire services, and police. On State concession operated roads the concession operator must supply emergency response, and the team witnessed this occurring at one serious rural crash as well as others. In some states there are helicopter rescue nodes. These are appropriately concentrated in large population clusters.

**Figure 8. A major head-on crash on a São Paulo State Highway with no median separation or sealed shoulder**



Other positive features of emergency response include that ambulances often have doctors, doctors may use motorcycles to reach crash scenes more quickly in heavy traffic, hospitals are selected for transport of patients based on daily updated information on bed and service availability, and GRAU (the Emergency Care Rescue Group) supply doctors to fire brigades. Improved collaboration between SAMU and the Health Department could improve locations of ambulances for effective coverage.

#### **Encouraging and facilitating reduced road use**

Further expansions of water, rail transport will assist Road Safety, and the National Plan for Integrated Logistics has as an objective the reduction of road use. From an urban perspective, the largest cities also have, among their mobility policies the reduction of individual motorized transportation.

In logistics terms, Brazil has a huge coastline, many ports and navigable rivers. Brazil has 8500 km of navigable coast. The Brazilian port complex handled 931 million tons of bulk cargo in 2013, an increase of 2.9% compared to 2012. According to ANTAQ (National Agency for Water Transports), Brazil transported via inland waterways routes, 38 million tons in the first half of

2014. According to the survey for economically navigable (and viable) routes, conducted by ANTAQ (2014), the main waterways in the country are: Amazon (17,651 km), Tocantins-Araguaia (1360 km), Parana-Tiete (1359 km), Paraguay (591 km), San Francisco (576 kilometers), south (500 km). Further expansion is feasible and is occurring.

## 5 RECOMMENDATIONS

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### 5.1 AREA OF OPPORTUNITY 1: INSTITUTIONAL LEADERSHIP, MANAGEMENT CAPACITY, CO-ORDINATION AND CULTURE CHANGE

Road Safety management in Brazil is fragmented with little accountability. For sustained success in Road Safety, Brazil must elevate leadership, create results focused management, a paradigm shift in cultural views of Road Safety, and appropriate accountability and responsibility for Road Safety matched by capacity to deliver.

**Recommendation 1: Establish clear, capable, responsible and accountable leadership of Road Safety for Brazil at federal, state and municipal levels.**

Recommendation 1.1: ***Establish a national Lead Agency for Road Safety*** and assign a complement of skilled staff, to perform the following functions:

- Elevate leadership, results focus, management, monitoring, and accountability and responsibility for Road Safety. The Lead Agency should hold accountability and responsibility for Road Safety and be able to assign accountability and responsibility for specific components of Road Safety.
- Increase collaboration and ownership of Road Safety across Federal Government, across government more broadly, within municipalities, and multi-sectorally;
- Galvanize community and NGO demand for Road Safety and acceptance of stronger actions to reduce road trauma;
- develop and employ a sound comprehensive crash database to monitor Road Safety performance, select Road Safety works, and refine programs;
- Take responsibility for Road Safety and lead most of the actions listed in this report
- Undertake training and promotion of safe systems to counter the common victim blaming behavior focus to the exclusion of more systems orientated solution focused thinking, and train engineers and road designers into safety focused decisions.

Recommendation 1.2: ***Assign the following to the Lead Agency:***

- The legal powers to lead, co-ordinate, manage, monitor, evaluate, and report on Road Safety works and delivery by other agencies of government;
- The power to propose and advance required legislation to Parliament;
- Direct control of marketing and promotions of Road Safety activities with appropriate budget, expertise, and the aim of appropriate attitude and behavior changes;
- Significant budget, in order to function fully as a Lead Agency with all necessary policy, monitoring, management, research and analysis capabilities;
- Human resources (expertise, skills and staff numbers) required to perform the full functions of a lead agency are significant, and could be built over time. As a guide the equivalent agency in the state of New South Wales in Australia had around 110 staff.

Recommendation 1.3: ***Seek multi-partisan congressional support*** and commitment to Road Safety and for the development of the Lead Agency, to enhance high level political support and profile for Road Safety.

Recommendation 1.4: ***Link the Lead Agency for Road Safety to the highest levels of authority***, directly to the President Office. Thematic secretariats (*Orgao Vinculado*) are created for special and specific purposes and Road Safety fits most appropriately into this category based on the breadth of cross-cutting issues, the economic impacts, the vertical and horizontal coordination required for successful deliver, and the epidemic of avoidable human suffering and loss involved. Ideally, the Lead Agency for Road Safety should not be within any other agency related to Road Safety to ensure that the Lead Agency is able to maintain an independent unbiased perspective on the Road Safety activities of all organizations and is not limited in its directions or analysis by any department or ministry to which it belongs. The highest level of political support is necessary for Road Safety in order to ensure its capacity to influence, coordinate, and monitor the Road Safety relevant activities of other organizations of federal government as well as facilitating its capacity to coordinate multi-sectorally, including state and municipal organizations.

Recommendation 1.5: ***Have the Lead Agency provide leadership, coordination and monitoring*** with partner agencies by:

- Assigning clear roles to the partner agencies, which avoid duplication and ensure that all activities required are explicitly within the responsibilities of an agency;
- Assigning accountability and responsibility for results;
- Providing valid precise key performance indicators, by which Road Safety delivery by each agency will be measured;
- Setting performance targets and monitoring achievement of these targets;
- Providing public reports to Parliament on the results of the monitoring, along with recommendations for any corrective actions necessary to ensure delivery of action plans, and the strategic targets for Road Safety for 2020.

Recommendation 1.6: ***Have the Lead Agency responsible for the crash database*** (eventually the Road Safety observatory), along with the expertise to conduct analysis of it. This may be most effectively achieved through the transfer of some research and analysis capacity and expertise from existing Road Safety research areas and departments of government, and discussions with the existing non-government National Observatory to allow continued data access.

Recommendation 1.7: ***Create a network of interacting state level lead agencies*** working closely with the national Lead Agency.

Recommendation 1.8: ***Establish a Committee*** comprised of the federal Lead Agency (as Chair) and all state government lead agencies, for national coordination.

Recommendation 1.9: ***The Lead Agency should assume the role of the Secretariat to CONTRAN*** (the National Council of Transport), in order to allow a close working relationship with (the revised) CONTRAN, including the provision of expert advice and evidence base for high level decisions.

Recommendation 1.10: ***Revise the membership and roles of CONTRAN, which should include the Lead Agency as a member***, ensuring a close working relationship with the new Lead Agency which should provide expert advice to the Committee. The role of CONTRAN should be revised from a leading role in deference to the expert leadership of the Lead Agency. CONTRAN should be a venue for broad approval of Lead Agency decisions, assignment of responsibilities, and organization of whole of government action.

Recommendation 1.11: ***Improve coordination and collaboration across agencies***, including across and between state, federal and municipal agencies. The Lead Agency should address this, along with CONTRAN as one venue for communication. Areas of inadequate co-ordination which could be addressed as priorities include:

- At the highest level, close working collaboration is required between the Lead Agency, and the Ministries of Transport, Cities, Justice, and Health;
- Drink-driving testing processes requiring input from multiple police forces (the Federal or State Police who detected the driver, the Civil Police and the Technical/Scientific Police branch) which can take many hours to achieve, expending police time, creating risk of charges being dropped due to the excessive time elapsed since the driver was arrested, and further limiting effective enforcement. In other countries the one police force undertakes the roadside tests, undertakes the formal (evidentiary) test and charges the driver. This model should be considered;
- Collaboration especially with NGOs to increase Road Safety understanding in the community and provide a conduit for genuine Road Safety messages;
- Collaborations across agencies required to improve crash data collection and database processes;
- Collaborations across agencies including all enforcement agencies to allow coordinated focused approaches to enforcement of key issues (speeding, seat-belt use, helmet use, drink-driving, vehicle registration) aligned with an enforcement emphasis in communications and advertising.

Recommendation 1.12: ***Develop a 10-year evidence-based strategy and full investment plan*** for Road Safety improvements, led by the Lead Agency in consultation with a broad range of multi-sectoral stakeholders including community representatives. Responsibility for key activities should be assigned to organizations and departments, with the heads of the relevant organizations being held accountable for on-time delivery.

The following recommendations in Area of Opportunity 1 are identified as short term actions (a time frame of around 6 months): 1.1, 1.3, 1.4, and 1.9. All other Recommendations in this area

are medium term, except that the part of recommendations 1.6 referring to the development of a full government owned Road Safety observatory is a longer term deliverable.

## 5.2 AREA OF OPPORTUNITY 2: CRASH DATA SYSTEMS DEVELOPMENT

A results focus (with accesses to appropriate information and analysis capacity) is a critical success factor in motivated, evidence-based Road Safety delivery.

**Recommendation 2: Create a sound, comprehensive nation-wide Road Safety crash database and uniform collection procedures, covering all roads and including the crash details required for more informed Road Safety management. The Federal Highway Police database is a sound base, which with improvement and expansion could provide a sound crash database.**

Recommendation 2.1: ***Use fatal and serious injury crashes as main performance indicators for Road Safety.*** All crashes may provide more data but the nature and location of minor crashes differs significantly from the most serious crashes; employing all crashes will lead intervention focus away from the most serious crashes.

Recommendation 2.2: ***Establish a multi-sectoral data working group,*** to create collaboration across required stakeholders and to assess the best Road Safety related data uses for all, review and create uniform (not minimum) crash data collection standards and processes, and oversee the development of data systems, leading to a comprehensive Road Safety observatory. This group should include representation from federal, state government, municipal government, and should consult NGOs including the existing Road Safety Observatory, as well as IRTAD. From the process, ***create a single database of crashes*** with at least the following features:

- Based on Police records of crashes because only police records can contain sufficient details of crashes, with collation of federal, state and municipal roads crash records;
- Revised minimum crash recording standards as set by federal law in consultation with federal, state and municipal stakeholders, to create agreed, quality, uniform crash data collection process;
- Fully flexible analysis capability available in the system;
- Deaths accurately recorded including tracking of injured people for 30 days after the crash;
- More reliable accurate recording of crash locations for better targeting of engineering treatments, for example through use of GPS or more rigorous recording systems than currently exist. Federal Police are currently undertaking GPS mapping of the kilometer marker posts on the federal road network and this will be required for all roads if better locations recording is to be uniformly achieved. Currently, in some states Road Safety works are sometimes identified from media reports of crashes because the crash database is less reliable for location than media reports;
- Recorded crash types to be significantly expanded to allow more effective management of crash types through better information on crashes;

- The single database to include records of which authority is the road owner: federal, which state, or which municipality, as an analyzable variable. This will allow every agency at federal, state and municipal levels, and the public, to single out crash data for each municipality or state of federal network and make performance assessments as well as monitor Road Safety more precisely;
- Full access to depersonalized crash information (not just summaries of it) for the media and the public, to facilitate advocacy and provide more transparent government;
- Creation of more systematic crash data driven processes to select locations and works for Road Safety and resist the current trend that communities which lobby for Road Safety works get Road Safety attention (and resources) regardless of the actual level of risk.

Recommendation 2.3: ***Publicly acknowledge the limitations of current national data collection*** for transparency of Government and in order to manage the risk of apparent increases in deaths due to improved data collection processes.

Recommendation 2.4: ***Have IPEA develop an updated estimate of the costs of crashes in Brazil*** using the most modern techniques and best estimates of numbers of deaths and serious injuries not the current database numbers

Recommendation 2.5: ***Foster the development of a Road Safety research expertise both in Government, universities and independent research centers.*** In particular, increased research and analysis capacity will be required within the Lead Agency, to manage the crash database within the Lead Agency.

Recommendation 2.6: ***The crash data re-development should be treated as a first major step towards a more comprehensive Road Safety observatory.*** Ultimately, the crash database should be the central element of a government controlled but publicly accessible larger Road Safety observatory which includes comprehensive data on many aspects of Road Safety exposure and risk, including additional elements of information such as population, various measures of the economy and of road usage, the network, alternative transport, etc. Consideration should be given to the role of the existing non-government Road Safety Observatory in this process as a means of public data access and dissemination.

The following recommendations in Area of Opportunity 2 are identified as short term actions (a time frame of around 6 months): 2.1, 2.3, and 2.4. Recommendations 2.2 and 2.5 are medium term and recommendation 2.6 is longer term.

### 5.3 AREA OF OPPORTUNITY 3: FUNDING AND RESOURCE ALLOCATION.

Crashes create epidemic levels of human and economic loss. Road Safety is not just charity work but a legitimate investment for the economy and inhabitants of Brazil, and greater funding is warranted.

**Recommendation 3: Sustainable appropriate funding and allocation of resources to effective safety measures are recommended as essential for effective delivery of Road Safety**

Recommendation 3.1: ***Develop a framework for Road Safety funding*** and its allocation, based on benefit cost ratios to be used by the Lead Agency and other organizations for prioritization of Road Safety expenditure. This will facilitate improved efficiency of Road Safety expenditures, through more rigorous selection processes based on benefit-cost analysis and lives and injuries saved, and better business cases for Road Safety investments.

Recommendation 3.2: ***Dedicate speed camera revenue to genuine Road Safety action and monitor to ensure appropriate expenditure.*** This commitment of speed camera revenue to Road Safety provides a relevant sustained (though inadequate and perhaps reducing due to reduced speeding) funding source for Road Safety and expresses a commitment from government to Road Safety as well as reducing the community misperception that speed cameras are primarily to raise revenue for government.

Recommendation 3.3: ***Dedicate Government income from Compulsory Insurance (Lider) to genuine Road Safety investments selected by the Lead Agency.***

Recommendation 3.4: ***Make funding of Road Safety sustainable by dedicating other specific funding resources.*** In addition to general taxation, and sources as recommended above, other sustainable revenue sources should be investigated and determined. Possibilities in use in other countries include Road Safety levies on vehicle licenses, and fuel charges dedicated to Road Safety.

Recommendation 3.2 in Area of Opportunity 3 is identified as a short term action (a time frame of around 6 months). Recommendations 3.1, 3.3, and 3.4 are medium term actions.

#### 5.4 AREA OF OPPORTUNITY 4: RESULTS FOCUS, MONITORING AND EVALUATION.

Monitoring and evaluation allow understanding of what is working and what is not, for performance monitoring and continual improvement of Road Safety delivery.

**Recommendation 4: Stronger accountability and responsibility for Road Safety with clear performance criteria on government organizations, monitoring of the criteria, and evaluation of programs are required to motivate, manage, and improve Road Safety delivery.**

Recommendation 4.1: ***Monitor expenditures dedicated to Road Safety, as referred to above.*** All agencies should maintain appropriate records of Road Safety dedicated income and expenditure and the Road Safety basis for the selection of works, and provide reporting, and full access to the relevant data, for the Lead Agency.

Recommendation 4.2: ***Adopt outcome and output performance targets for Road Safety and include these in performance contracts of heads and senior executives*** of all relevant federal government agencies, and state government agencies, with monitoring by the Lead Agency, so

as to strengthen intergovernmental horizontal and vertical coordination, accountability and motivation. Employment contracts should include responsibility and accountability for delivery of Road Safety as agreed with the Lead Agency and the requirement for full co-operation with the Lead Agency including in the monitoring of the performance of relevant agencies.

Recommendation 4.3: ***Systematically evaluate and monitor actions for Road Safety.*** Often, Road Safety delivery is not evaluated, and thus failures can be perpetuated, and successes may go unnoticed.

Recommendation 4.4: ***Carry out systematic annual comparable data collection (by direct means not self-report) to monitor behavioral change.*** A systematic annual comparable data collection process is needed to determine levels of:

- Speeding in each level of speed zone (not at speed camera locations);
- Drink-driving;
- Seat belt usage;
- Child restraint usage;
- Motorcycle helmet usage;
- Safety of infrastructure (ratings, presence of barriers, etc.);
- Proportion of the vehicle fleet which is 4 or 5 star Latin NCAP rated.

*Expert statistical advice should be sought to determine sample sizes.* For behavior change programs, there is a dearth of intermediate outcome data for assessment of the extent of problems and evaluation of Road Safety programs to address them. Sample sizes for on-road surveys of seat belt use, etc. are often excessive, increasing expense unnecessarily.

The following recommendations in Area of Opportunity 4 are identified as medium term actions: 4.1, 4.2, and 4.4. Recommendation 4.3 is suggested as a longer term action.

## 5.5 AREA OF OPPORTUNITY 5: RESEARCH, DEVELOPMENT AND KNOWLEDGE TRANSFER.

Research, development and staff development are needed to sustain Road Safety improvements are occurring to an inadequate extent.

**Recommendation 5: Exercise care in determining what to research and build capacity of Road Safety staff across federal, state, and municipal agencies**

Recommendation 5.1: ***Exercise care in determining when to undertake research versus when to adopt successes from elsewhere.*** Various aspects of Brazil are unique, but many aspects of Road Safety are shared with other countries: Brazil can save time and resources through judicious decisions regarding the extent to which successful actions elsewhere can be transferred to Brazil. (One distinctive aspect of Road Safety in Brazil is the excessively high ratio of disabilities to serious injuries, or the ratio of disabilities to deaths).

Recommendation 5.2: **Road Safety research skills must be amplified** in universities, institutes and government organizations, to ensure research and development is possible when needed.

Recommendation 5.3: **Build capacity of Road Safety staff across federal, state, and municipal agents including safe systems** and other training, and provide appropriate powers and influence. Staff capacity building and knowledge transfer are needed to improve Road Safety, though small pockets of expert Road Safety staff exist. Selected Universities in Brazil could develop Road Safety training packages to produce a much needed local stream of Road Safety skilled staff.

Recommendation 5.4: **Provide transfer of knowledge through more specialized training, including safe systems training.** These staff should be able to assist in the training of staff in Brazil, including providing greater understanding of Road Safety and safe systems to staff not seen as Road Safety but who are involved in related activities. A number of courses for formal training in Road Safety exist now (e.g., at Delft University in the Netherlands, CARRS-Q or Monash University, Australia, or could be developed in Brazilian universities).

All recommendations in Area of Opportunity 5 are identified as medium term actions except recommendation 5.2, which is longer term.

## 5.6 AREA OF OPPORTUNITY 6: MULTI-SECTORAL PROMOTION, ADVOCACY, AND EDUCATION FOR ROAD SAFETY

These areas of promotion and education are combined because they often overlap in process and project, with communications designed to both promote and educate.

**Recommendation 6: Road Safety promotion and education in Brazil needs to be best practice, more systematic, consistent, and evidence based.**

Recommendation 6.1: **NGOs, private enterprise, and the community must be more engaged in promotion of, and understanding of, Road Safety.** The key role of government and the need for strong decisions in Road Safety should be a core part of messages to the community in educational/awareness raising communications and campaigns. NGOs may contribute more to Road Safety through advocacy for stronger government action, thus both pushing and allowing governments to do more.

Recommendation 6.2: **Foster independent Road Safety commentary from universities and the research community.** Road Safety researchers can be valuable Road Safety advocates to government, the media, and the community.

Recommendation 6.3: **Establish a multi-partisan Congressional Road Safety Committee,** with the role of conducting enquiries into specific Road Safety issues and producing public reports advising Government on Road Safety actions, from a sound and rigorous evidenced based standpoint not on a popularity basis. The Lead Agency should provide technical advice to the Committee.

Recommendation 6.4: **Strengthen Road Safety Government partnerships with industry and business**, and facilitate and reward sound safety culture through such policies as making Road Safety performance a factor in the letting of government tenders. Adoption of the International Standards Organization Road Safety Standard (ISO 39001) by companies could form the basis for this process.

Recommendation 6.5: **Offer systematic age appropriate education on Road Safety to school-age children delivered by school teachers**. Road Safety education should be comprehensively reviewed by Road Safety experts to ensure systematic coverage as part of the school curriculum, which should not include driver or any motorized two wheel training at school age because evaluations have shown that this is not useful for Road Safety and may increase crash risk.<sup>63</sup> Ad hoc visiting Road Safety presentations by well-meaning but non-expert teachers should be abandoned. Road crashes cause more deaths among school age children than any other cause of death.

Recommendation 6.6: **Sustain effort in effective media coverage for Road Safety action**. Additional actions for the development of media coverage in the medium term should include:

- Making crash data fully accessible to media for public scrutiny, credibility and transparency of government, at federal, state and municipal levels (with the development of the new comprehensive crash database, as occurs now at the federal level for DataSUS);
- Increased use of paid media for Road Safety messages.

Recommendation 6.7: **Paid media advertising including posters for Road Safety should be more evidence-based, including establishing (through research) the current relevant attitudes, beliefs, and behaviors**. Media campaigns based on credible enforcement work more effectively for behavior change than most campaigns and especially more effectively than campaigns based on severe crashes (because of perceptions of invulnerability and driver overconfidence), or knowledge based campaigns (because Road Safety problem behaviors are generally a motivation problem not a knowledge problem).

Recommendation 6.8: **Organize, on a yearly basis, publicly accessible annual multi-disciplinary national Road Safety conferences**. Such conferences should: (i) review the Road Safety performance of the last year; (ii) allow analyses of performance to be presented from independent experts, researchers and auditors; and (iii) allow dissemination on successes and failures. Strong media presence should be encouraged to improve public understanding and government accountability.

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<sup>63</sup> Roberts IG & Kwan I (2008). School-based driver education for the prevention of traffic crashes (Review). Cochrane Library (Wiley).

For this Area of Opportunity, Recommendation 6.7 is identified as short term action while all other recommendations in area of opportunity 6 are medium term.

## 5.7 AREA OF OPPORTUNITY 7: ROAD SAFETY DELIVERY BY STATES AND MUNICIPALITIES

Municipalities manage 77% of the road network of Brazil. There are too many municipalities in Brazil (5,570), resulting in many with too few residents, too small a tax base, resources and capability to manage the Road Safety of their roads, leading to a core misalignment of responsibility, accountability, capability, and power in the role of the municipalities in Road Safety for Brazil.

**Recommendation 7: Galvanize municipalities to effective action and realign the capacity of municipalities for Road Safety delivery with the assigned accountability and responsibility.**

Recommendation 7.1: ***Increase Municipal accountability and capacity.*** Capacity can be increased through four possible mechanisms (which are not mutually exclusive):

- Legislated amalgamations to reduce the number of small municipalities, and preventing the creation of more municipalities;
- Encouraging and facilitating collaborations across multiple municipalities to allow them economies of scale and the potential to create processes and capabilities for Road Safety management, including municipalizing traffic as a consortium of municipalities rather than separately;
- Allowing the operation of speed cameras primarily for Road Safety via better management of speeding but also to provide a revenue stream for other Road Safety activities, without requiring full municipalization of traffic. This could be regulated by requiring that all funds raised are spent on Road Safety works including preparation for municipalization of traffic;
- Funding municipalities directly to undertake Road Safety related activities.

Alternatively, responsibility for Road Safety could be reduced in a number of ways:

- Road Safety management on municipal roads may be funded (and managed) from federal or state revenue;
- State Police currently have some responsibility for enforcement and safety on municipal roads, but the level of delivery is not strong. Investigation of changes to the current practices is recommended, including the option of full delivery of non-automated enforcement by State Police taking over all enforcement on Municipal roads, in a management partnership with the Municipalities. This will also reduce duplication of infringement issuing staff and appeals processes.

Some of these suggested solutions may require changes to the 1988 constitution and the amendment in 2014 (amendment number 82).

Recommendation 7.2: ***Municipalities must take more ownership of the Road Safety problems on the roads for which they are accountable***, and federal and State should assist with this change. Mechanisms by which the situation may be improved include:

- Ensure accountability is for undertaking genuine Road Safety programs, not naïve but well intended local education programs;
- Employ the new national database to publicize Road Safety records of municipalities and create more demand for safety from the local communities;
- Performance and project tied funding by state and federal governments;
- More effective funding support for Road Safety works, including more rigorous control of the expenditure of funds raised for Road Safety (such as from DETRAN, speed cameras, etc.) to ensure they are genuinely spend on Road Safety;
- Assistance to Municipalities in identifying the real crash blackspots on their road networks and ensuring the Road Safety works are targeted on the basis of this sound evidence rather than to appease residents perceptions of safety;
- Delivery of strong sustained seat belt, helmet and speed enforcement on local roads by municipal agents;
- Specified percentages of municipal revenue to be dedicated to genuine Road Safety works selected based on Road Safety benefit-cost ratios, and monitored by the State.

Recommendation 7.3: ***Establish State Government-Municipalities Road Safety Liaison Committees in each state, chaired by the State Lead Agency*** for Road Safety to galvanize and facilitate Road Safety activities on municipal roads (including advocating the solutions in this section), and drive an evidence based, safe systems approach to Road Safety.

All recommendations in area of opportunity 7 are identified as medium term with elements of recommendation 7.1 being longer term to achieve.

## 5.8 AREA OF OPPORTUNITY 8: MANAGEMENT OF THE ROAD NETWORK

Brazil's roads and especially roadsides are a key, largely untapped, opportunity for improved safety. Safe roadsides can save riders and drivers (and save others from those riders and drivers) who are fatigued, speeding, distracted or otherwise impaired, and safe amenity for pedestrians and other vulnerable road users can save them from risk taking and misjudgment.

**Recommendation 8: Adopt Safe Systems principles in determining planning, design, retrofitting, maintenance and operational guidelines, standards, and decisions regarding Brazil's roads, with increased focus on roadsides. Works should be delivered according to the following priorities: (i) Highest: works which prevent the mechanisms of injury or death (such as barriers, with safe end treatments, median separations, roundabouts); (ii) Medium: works**

**which force speeds down to reduce crash forces; and (iii) Low: works which assist the road user not to make an error (e.g.: signage).**

The core role of Road Safety engineering works should be expanded from the view that Road Safety is largely the cosmetic add-on of ‘signs and lines’, in the optimistic hope that these will cause drivers and road users to behave safely. The “guide the driver” approach to Road Safety (with signs, lines, and education) has failed worldwide and Road Safety has moved from assisting the driver to the safe systems approach of preventing the serious injuries and deaths despite inevitable human error.

**Recommendation 8.1: *Provide more forgiving roadsides on high traffic volume roads with serious crashes:***

- Establish an immediate policy of providing forgiving roadsides (preferably barriers but also clear zones) and full and forgiving median separation on all new high speed divided carriageway roads. Choices of road design treatments should consider motorcycles where they are involved in serious off road crashes;
- revise design guidelines which allow for high speed dual carriageway roads with medians which are unsafe (such as unprotected ditches, headwalls, trees, and poles) or allow for errant vehicles to cross the median risking head on crashes.

**Recommendation 8.2: *Review planned road rehabilitation and construction expenditure with a view to dedicating at least 10% of funds to proving forgiving roadsides rather than a continuing focus on improved road surfaces.*** Forgiving roadsides are more effectively created through barriers not clear zones (which by the standards in use are much smaller than genuinely required to provide safety).

**Recommendation 8.3: *Address the poor safety record of undivided rural roads by providing safer roadsides, through:***

- Preferably barriers but also clear zones especially on curves;
- Wider sealed shoulders, avoiding drop-offs on the edge of the travel lane;
- Improved management of speed (see next set of recommendations);
- Improved roadside delineation, particularly rumble strips or profile line marking.

**Recommendation 8.4: *Undertake iRAP*** (International Road Assessment Program) rating on a selected sets of federal and state roads in Brazil and fund treatments to address identified weaknesses.

**Recommendation 8.5: *Where crash data allow, commission analysis to establish black spots and black lengths of roads and engineering solutions*** which have the potential to deliver

significant casualty savings and deliver a costed program of infrastructure improvements, addressing the locations. Careful data preparation should allow for evaluation, including pre-change crash data and exact dates of start and end of works at each location.

Recommendation 8.6: ***Establish a funded program of demonstration projects in pedestrian casualty crash areas.*** Amenities for pedestrians are often inadequate in many cities and on many rural roads around population centers where pedestrians walk along the road. The recently released WHO Pedestrian Manual<sup>64</sup> could assist treatment selection. In 2012, over 8,000 pedestrians were killed and over 40,000 were seriously injured in Brazil.

Recommendation 8.7: ***Adopt improvement for pedestrian safety,*** including:

- Allowing for pedestrians to cross main roads in one movement rather than being stopped in the median by the signal cycle, or better still providing overhead crossings and pedestrian fencing;
- Provide more time to cross the road at signalized crossings;
- Move towards safe system speed limits where pedestrians cross roads;
- Vigorously enforce pedestrian right of way at crossings.

Currently, traffic flow appears to be a priority over pedestrian safety.

Recommendation 8.8: ***Factor in pedestrian amenities for safe crossing in bus lane design.*** Increased accommodation of bus transport through the provision of bus lanes has clear advantages for public transport and buses offer increased safety for occupants. However, the rigid more vertical fronts of buses result in much more severe injuries and a higher probability of deaths for pedestrians when struck by a bus, even at low speeds. Thus, planning for bus lanes should include increased amenity for pedestrian crossing, and placement of these crossings should be carefully considered in relation to the location of bus stops and the obscured vision of pedestrians for other drivers created by buses.

Recommendation 8.9: ***Review and revise land use planning policy in relation to impacts on Road Safety,*** especially in relation to safe provision for generation of pedestrian traffic as well as vehicular traffic. Good safety oriented land use planning can reduce the need for road transport, reduce the need to cross roads, and thus reduce exposure to risk.

Recommendation 8.10: ***Review laws and policies to better prevent and better manage the safety risks created by encroachment of shops and buildings into the road reserve.*** Encroachment is a significant Road Safety issue because of the pedestrians drawn to the roadside shops, the lack of space for pedestrians to walk safely, and the lack of space for improved road design.

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<sup>64</sup> WHO (World Health Organization) (2013). *Pedestrian Safety: A road safety manual for decision-makers and practitioners.* WHO: Geneva.

Recommendation 8.11: **Establish sustainable well-funded programs of evidence-based demonstration projects** on high casualty crash rate federal and state non-dual carriageway (and dual carriageway if high casualty crash rates exist) roads, and begin selecting and planning the first round of works for commencement in 2016.

Recommendation 8.12: **Establish a funded program for the installation of roundabouts**, which reduce collision severity, and slow traffic when correctly installed to require a significant change of angle in negotiating the intersection, and thus improve safety for pedestrians as well as vehicle occupants. Mini roundabouts should also be included to improve safety of smaller intersections. The design of the mini roundabouts should still ensure that vehicles are forced to an appropriate change of direction at the entry to the intersection to capture the benefits of the roundabout.

Recommendation 8.13: **Stop the construction of 'open' (or 'hamburger') roundabouts and retrofit closure of existing examples.** The design of open roundabout intersections removes their Road Safety value by having the main highway going straight through the middle of the roundabout. The advantages of lower angles of collision and reduced speeds at the roundabout are therefore circumvented. The design and installation of such roundabouts should be stopped immediately, and a program of retrofitting to prevent any vehicles from going straight through the roundabout should be initiated and planned (for funding and implementation over the next three years).

Recommendation 8.14: **Ensure responsibility and accountability for Road Safety improvements by private companies** managing (concession) toll roads through contractual arrangements, including and commitment to articulated outputs and clear, measureable ambitious Road Safety targets in death and injury reduction outcomes. These must be monitored and contracts must include substantial financial consequences.

Recommendation 8.15: **Design / retrofit roads with off-road bicycle lanes, where bicycle use occurs.** Bicyclists are a substantial component of road deaths and injuries in Brazil (with over 1,400 deaths and over 8,800 serious injuries). Bicycle safety should be improved by the provision of off road cycle-ways, and by reduced traffic speeds.

Recommendation 8.16: **Training and management are required to improve the safety of roadside work practices**, which on road observations show are currently inadequate.

Recommendation 8.17: **Knowledge transfer is called for to address a number of factors which limit the progress towards safer road designs and operation, including:**

- A continuing strongly victim blaming culture, which is supported by the behavioral focus of publicly promoted Road Safety interventions (which are focused on drink-driving, distraction, etc. not the road);
- A continuing focus on roads for cars and trucks, while the safe amenity of vulnerable road users (pedestrians and two-wheeled vehicles) remain a secondary priority;

- A common view that Road Safety is about the cosmetic add-on to guide road users (signage and line marking);
- Safe system principles are not well known and are poorly understood, even in some Road Safety circles;
- Safe systems principles are seen as beyond the financial reach of Brazil and mistakenly seen as irrelevant for the level of expenditure the country has for Road Safety.

Recommendation 8.18: ***Within roads agencies especially at state levels, realign organizations to address structural factors that underlie the slow progress towards safer road designs and operation:***

- The small number of Road Safety staff who have a better understanding of safe systems are typically marginalized and disempowered;
- Road Safety is often restricted to control of lines and signs only and may have no input to new road design and building, intersection management, or road design guidelines.

Recommendation 8.19: ***Improve the roadside safety furniture,*** including:

- Unsafe end terminals on guardrail, such as fishtails and sloped ends;
- Unsafe ends on concrete barriers and bridge walls, including vertical concrete ends and sloped end terminals (often known as launching pads for the way cars go airborne on impact);
- Guardrail which has been damaged in crashes and is no longer effective must be repaired;
- Power and other poles are placed near roads creating risk of impact with infrangible objects. Policies to place these as far from the road as possible or protect them with barriers (especially poles on the outside of curves) will significantly assist Road Safety.

Recommendation 8.20: ***The state road authorities in some states collect animals from the roadway to prevent serious crashes into animals*** (especially at night). However, these animals are maintained on farms at significant expense due to inability to destroy or sell the animals. It is recommended that this inability to get rid of unwanted animals be resolved by allowing that the animal can be humanely destroyed or sold for other uses, after a short time in which the owner can (for a fee) collect the animal. This would allow expansion of the program and yet reduce net costs.

Within Area of Opportunity 8, a number of recommendations which will take medium term to fully embed as ongoing processes, can nonetheless be started in the short term, including 8.1, 8.2, 8.3 8.6, 8.7, 8.13, 8.16, and 8.19. Actions 8.1, 8.3, 8.7, 8.13, 8.19 all offer feasible opportunities for early wins in Road Safety delivery if they can be initiated in a short timeframe at state and/or federal levels. The remaining recommendations are suggested as medium term actions, except recommendation 8.9, which is longer term.

## 5.9 AREA OF OPPORTUNITY 9: MANAGEMENT OF ROAD USER BEHAVIOR

On-road observations as well as available crash data identify a number of on-road risky behaviors: speeding (most important and addressed separately in the next area of opportunity), non-use of available seat belts, non-use of child restraints, non-use of motorcycle helmets (motorcycles were addressed above), non-use of bicycle helmets, drink-driving, and dangerous use of the road by pedestrians and cyclists. Effective management of these behaviors requires changes in legislation, on-road enforcement, infringement processing, penalties, and promotion (see principles covered in earlier section).

**Recommendation 9: Unsafe road user behavior must be improved via more effective, unpredictable, unavoidable genuinely deterring enforcement, and promotion/education of the community regarding this enforcement. Road Safety is largely a motivation problem not a knowledge problem and thus enforcement not education alone is needed.**

Recommendation 9.1: *The following legislative and policy changes are recommended:*

- ***Make illegal, ban and prosecute systems that provide warnings of locations and times of enforcement to drivers over mobile phones and the internet.*** Distraction and punishment avoidance are being facilitated, allowing more dangerous driving without effective deterrence. If the websites cannot be closed, down Police and Road Safety advocates should provide them with false information to present the appearance of massive amounts of enforcement and render their information less effective for punishment avoidance by road users. The argument that warnings encourage drivers to obey the law is fallacious: warnings of everywhere enforcement exists in effect tell drivers where enforcement does not exist. Thus these warning systems encourage illegal driving on most of the road (which contains no enforcement);
- ***Move enforcement locations regularly*** (especially drink-drive and speed enforcement). Ideally, enforcement officers should monitor the websites which inform of locations and move soon after their location is posted on the sites;
- ***Reduce reliance on Police posts*** as an enforcement location in favor of more mobile enforcement to make the enforcement less predictable, and more effectively anywhere anytime;
- ***Make bicycle helmets compulsory.*** Bicycle helmets improve safety but wearing rates are minimally affected by education campaigns alone. Bicycle helmets should be made compulsory and enforced, after strong communications campaign explaining the Road Safety value and the new law;
- ***Adopt a strong Graduated Licensing Scheme.*** Graduated Licensing schemes (GLS) provide gradual release from the restrictions of learning towards obtaining a full license, usually over several years. Such schemes have been evaluated and have been found to provide strong reductions in young driver fatal and injury crash involvements. Recent refinements to this program have yielded strong Road Safety gains. A strong GLS for motorcycles in particular will help to address the large and disproportionate number of deaths and injuries suffered by motorcyclists;

- **Introduce express wording prohibiting driving under influence.** Nowhere do the traffic rules expressly prohibit driving under the influence of alcohol. The penalty is established later in Chapter XV, which deals with penalties, but the prohibition of drunk driving is not included in the rules of the road that the driver has to learn and remember.

Recommendation 9.2: **Establish a high level multi-sectoral legislative working group** with representation from relevant Federal and State government agencies reporting to the Lead Agency, to review and advise on legislative and regulatory change with a report of recommendations due by mid-2016. The following issues should be considered:

- **New laws on drink-driving** are a clear improvement but are not a strong solution because, once the driver refuses the breath test, they can only be guilty of drunk-driving via witnesses attesting to their impairment. There are four key problems with this: First, there are procedural problems for police in proving the impairment and thus cases are less likely to be prosecuted. Second, the real limit for drink-driving is not zero but a level of alcohol which makes the driver visibly impaired. Third, impairment of driving is known to begin at low alcohol concentration, much lower than the level at which the driver is visibly impaired to a witness. Thus, drivers are able to drink to a level which impairs their driving but not be charged. Finally, this situation profoundly damages the general deterrence created by enforcement because drivers believe that by refusing the test they can avoid being charged and may believe that they will not look impaired to a witness;
- In order to address the legal right to refuse the breath test, **create the legal principle** (operating in most developed countries with good Road Safety records) **that driving is a privilege**, not an inalienable right, for which certain searches and tests are warranted (analogous to a security check to enter the parliament, though such a search may be refused elsewhere in the country). Alternatively, the process of obtaining a driver's license could require agreement by the driver that for the privilege of being allowed to drive on public roads tests such that random breath testing are allowed and that the penalty for breaching this agreement is equal to the highest penalty for drink-driving. In essence, the legal obligation to submit oneself to alcohol testing on the roadways of Brazil by authorized personnel should be included among the conditions for obtaining a driver's or rider's license as one of the terms of the contract by which the license is obtained;
- If the above cannot be achieved, then the **penalty for driving drunk** (as attested to by witness after a breath test is refused) **should be made significantly higher** than the penalty for being over the legal limit even by a large margin. This is justified on the basis that to be visibly impaired is a severe level of drinking regardless of the BAC at which this occurs, and thus the behavior is more dangerous and the offence is much more serious. This change in law, along with strong publicity on it, will actively discourage drivers from refusing the test and add to the deterrence value of drink-driving laws.

Recommendation 9.3: ***The following changes to on-road enforcement*** are recommended:

- ***Initiate a multi-government collaborative program with stronger enforcement across all police*** to improve seat belt wearing and child restraint use, including strong communications to the public and to Police regarding the importance of seat belts and child restraints and the enforcement of their use. This should be preceded by and accompanied by strong communications and paid media promotion to the community warning some weeks in advance of the strong enforcement coming in order to maximize general deterrence;
- ***The heads of all Police forces must also ensure that Police provide a role model and wear their seatbelts*** (which has not led to reduced crime prevention in other countries which have adopted this policy). Many police officers were observed not wearing seat belts;
- ***Breath testing for alcohol is best done randomly*** with a high level of publicity and visibility. Random visible testing creates stronger general deterrence and attitude change<sup>65</sup>, the keys to broad behavior change. However, locations should not be predictable allowing drivers to avoid detection by avoiding certain locations;
- ***Expand the successful federal Rodovida*** program model and monitoring to other police forces;
- ***Expand the multi-sectoral collaborative Balada Segura*** program currently in Rio Grande do Sul and revise operations so that locations are changed quickly to reduce driver avoidance through warnings of locations;
- ***Integrate better drivers' license systems***, so that drivers cannot register in several states and cannot get several licenses. A nationally coordinated effort is required to close this loophole;
- At the state level, ***increase availability of breath testing equipment*** for effective enforcement of drink-driving especially with the new laws. Breath testing equipment should be increased, along with equipment maintenance programs. This may be better managed by contracts for supply of equipment which include supply of maintenance not simply equipment;
- ***Enforce effectively maximum driving time for truck drivers***, who often drive excessive hours. In order to improve management of this risk by the trucking companies, effective enforcement is needed along with strong penalties for bad driver behavior which should be applied to the companies as well as the drivers;
- ***Regulate and enforce to preserve footpaths as places for pedestrians to walk***, by preventing them from being taken over by parking, commerce, repair businesses, and construction, forcing pedestrians onto the street;
- ***Revise the required roles of the different branches of Police in creating a drink-drive charge***, to allow the process to be more efficient and less time-consuming. Radical changes may be necessary such as allowing road police to conduct testing (with

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<sup>65</sup> Job, RFS, Prabhakar, T., & Lee, S.H.V. (1997). The long term benefits of random breath testing in NSW (Australia): Deterrence and social disapproval of drink-driving. In C. Mercier-Guyon (Ed.), *Proceedings of the 14th. International Conference on Alcohol, Drugs and Traffic Safety, 1997*. (pp. 841-848), France: CERMT.

appropriate training) or having scientific/technical police present at all significant breath test operations.

Recommendation 9.4: ***The following changes to penalties*** are recommended:

- ***Fines should be reviewed and increased but with consideration given to the minimum wage.*** Consideration should be given to ways in which differential levels of penalties could be applied for people with particularly low incomes, so that the fines match the offender's ability to pay keeping in mind that the point of the fine is to punish and thus deter. Possible measures by which ability to pay may be determined include income, or access to specific welfare as a guide to low income. (The alternative of using the value of the vehicle driven is not supported on the basis that it encourages the retention of older less safe vehicles and motorcycles). Fine amounts have not kept pace with Brazil's economic growth over a number of years, and are thus not sufficient to deter many drivers. Federal and state police and municipal guards identify this as a significant issues in many states and municipalities.

Recommendation 9.5: ***The following actions regarding infringement and penalty processing*** are recommended:

- ***Simplify the juridical labyrinth of information processes to the potential offender*** and available appeal process exist in Brazilian law, largely based on old world Portuguese and Spanish legal systems. This must be reviewed and simplified, to allow smoother faster delivery of penalties. Costs to road users for unsuccessful appeals must be added to overcome the use of free appeal processes as a means of delay.
- ***Encourage fine payment on time***, to deter unregistered motorcycle and vehicle use. Lack of motorcycle registrations can be encouraged by the build-up of tickets, so that the cost of paying these at the time of registration can be as much as the motorcycle is worth. This then motivates owners to ride the motorcycle unregistered and thus not pay the fines. For this reason and in order to create a stronger psychological connection between the illegal behavior and the penalty, it is important to motivate earlier payment of fines rather than waiting until the vehicle registration falls due. This may be achieved by a substantial increase for not paying at the time, and by vehicle impoundment for drivers caught with outstanding fines after a certain period is allowed to pay them. Enforcement of this policy could be facilitated by automatic number plate recognition. In addition, offenders should have the opportunity to pay the fine quickly (though not to police on the roadside).
- ***Address the current circumstances which allow offenders to delay paying fines for long periods with little consequence.*** First there is an excess of opportunity to challenge the penalty, with the first point of challenge being free even if rejected. Second, if the fine is not paid quickly (which appropriately results in a discount) then the offender can wait up to a year before paying and pay when their driver's license of vehicle license is due. Finally, by selling the vehicle (or otherwise disposing of it rather than re-registering it) the fines

may be avoided altogether. This situation is well known to motorists and results in profound damage to the essential deterring effects of enforcement in Brazil, because the penalty is seen as at least greatly delayed or entirely avoidable. Furthermore, even vehicle impoundment processes designed to address this problem (if a vehicle is detected with fines overdue) are not working effectively (due to lack of vehicle storage space).

- **Review and streamline the inefficient and costly duplication of infringement processing units.** There are many infringement processing units (at state, federal, and municipal levels) all issuing penalties and dealing with appeal processes as well as supposedly entering information into driver license databases.
- **Minimize punishment avoidance** to capture the full benefits of effective enforcement, including by the following methods:
  - *Remove unregistered motorcycles and other vehicles* from the road using fleet, as well as to aid detection of unlicensed drivers. Automatic number plate recognition is an important technology for road enforcement which should be adopted broadly for these purposes. However, its efficacy will be improved by making the motoring community more aware of its existence. Thus, it needs to be visible and strongly promoted to create general deterrence;
  - *Prevent the publicizing of enforcement locations*, as far as possible, because knowing where enforcement is equals knowing where enforcement is not and thus where drivers can feel safe from enforcement to drive dangerously (speeding, drink-driving);
  - *Rental rather than purchase of enforcement equipment including maintenance contracts, will reduce enforcement failures.* Some states have gone without legally usable breath alcohol testing devices for many months;
  - *Ban radar detection devices* in vehicles and this should be vigorously enforced, with advance warnings to drivers of at least one month. It should also then be illegal to sell or supply such devices in Brazil.

Recommendation 9.6: ***The following actions are recommended in relation to communications and promotion*** of enforcement for behavior change:

- ***Initiate a communications strategy*** to alert the community and promote Road Safety effectively and systematically;
- ***Strong publicity and communication campaigns*** should accompany and provide advance warning of changes of law, increases in penalties, and stronger enforcement processes;
- ***The Road Safety Lead Agency must include staff with a sound understanding of the psychology of Road Safety*** promotion and behavior change (which is not the same as communications expertise);
- ***Promote media coverage of Road Safety issues.*** Effective media coverage in itself can be a powerful communications tool for Road Safety action. Short term actions should include:

- The sound evidence base for Road Safety actions should be presented to the media in briefings and discussions;
- Presentations of research results, such as crash data analyses, rates of speeding, seat-belt use and community attitudes;
- Realign faith in training as a solution to the road toll with presentation of the evidence for its general failure.
- **Move education and promotion to best practice** in terms of content, targeting, and alignment with enforcement through:
  - Closely connecting in time and content Road Safety promotion and enforcement, because enforcement, not crash risk, is shown to be the most effective motivator of on-road behavior change. Practical experience shows that the combination of enforcement and promotional messages about the enforcement produces much larger benefits than either alone;
  - Training and expert advice on international best-practice in combining promotion and enforcement to leverage greater Road Safety gains.

Recommendation 9.7: **Set targets for management of enforcement and penalty processes**, and continually strengthen processes and policies until these are achieved:

- 95% seat belt use in vehicles;
- 99% helmet use for motorcyclists;
- 1 random breath alcohol test per 3 drivers per year;
- 80% of fines paid within 2 months.

All recommendations in Area of Opportunity 9 are overall medium term. However, certain elements of recommendations are suggested as short term actions due to their feasibility and potential for quick wins. These include: Recommendation 9.1, dot point on moving enforcement locations regularly; the first two dot points of recommendation 9.3 on seat belt enforcement and the communications elements of 9.6 associated with seat belt enforcement.

## 5.10 AREA OF OPPORTUNITY 10: MANAGEMENT OF TRAVEL SPEEDS

Speeding is the largest single behavioral contributor to serious and fatal crashes in Brazil. The evidence for the critical role of speed on crash occurrence and crash severity is irrefutable. The best performing Road Safety countries have large speed camera programs and generally lower speed limits (including Germany, except for some autobahns). The evidence also shows that higher open road speeds are not simply better for the economy, because the increased costs to the community of crashes, injuries and deaths, additional fuel usage, and vehicle wear outweigh the benefits of time saved.

**Recommendation 10: Define safer speed limits, road engineering, comprehensive aggressive enforcement, and strong media and communications campaigns to combat the misperceptions that speeding is not a safety issue and speed cameras are for revenue raising, and to promote the risk of detection and its consequences.**

Recommendation 10.1: ***Employ inexpensive road engineering interventions*** to manage speeds, including:

- Extensive use of speed humps (with advance warnings via signs and transverse raised lines) including on rural roads on approaches to risky curves.<sup>66</sup> Consideration of “modernizing” by replacing speed humps with speed cameras should be dismissed. Speed humps are permanently effective whereas cameras require maintenance and may not work 24 hours per day. Speed cameras have a critical but different role;
- Lines painted onto urban roads so that the lanes appear narrower, which slows travel speeds;
- Strong gateway treatments at the entry to urban areas, including narrowing the lane and speed humps;
- Well-designed roundabouts;
- Raised platform pedestrian crossings.

Roads features are a key mechanism by which speeds can be managed. Driving the roads of Brazil inevitably shows the value of speed humps which slow drivers at urban entry points more effectively than speed limit signs.

Recommendation 10.2: ***Strongly promote speed cameras for roads safety, commit spending all revenue raised on Road Safety***, and make the public commitment to and subsequently implement a substantial increase in effective speed enforcement, including:

- ***Increase substantially fixed speed cameras***, mobile speed cameras, and red-light speed cameras, to be steadily implemented over the next 3 years on federal, state and municipal roads. Mobile cameras should be deployed to large numbers of locations to maximize general deterrence from the belief that speeding motorists can be caught anywhere, anytime (and this message should be promoted);
- ***Rollout of point-to-point or average speed cameras*** on federal, state and possibly municipal roads. These cameras have proven to be very effective in managing speed over longer sections of road, and should be introduced on the Highways and urban arterial roads;
- ***Ensure that automated speed enforcement works at night***. Many current speed cameras do not work at night, creating a major limitation on deterrence of speeding.

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<sup>66</sup> Problems of advance warning to drivers of speed humps arise from signs being stolen and “sonalizers” (transverse audio rumble strips) not being permitted. One solution may be the use of horizontal signage- with the words “speed hump” painted in the middle of the lane on approach. Keeping to the middle of the lane will reduce tire wear and maintenance costs.

- **Continuing hands-on speed enforcement** by Police at all levels of government. It is critical that police maintain a strong level of speed enforcement, accompanied by a strong communications campaign of this policy;
- **Include at least 40% of mobile cameras** as unmarked with no requirement for visibility, based on the evidence that the mix of marked and unmarked (covert) cameras works best, with strong public communications that this is coming starting at least 4 weeks in advance of the change. All entry locations of point-to-point should be signposted;
- **Allow that all new cameras issue warning letters only for the first month** of operation to allow motorists further grace for the new enforcement regimen (these should not include the speed of the vehicle because this can encourage racing and competing for the highest speed on a warning notice). Seek input from an expert Road Safety psychologist on the wording of the warning letter;
- **Revise and reduce speed enforcement tolerances.** International evidence and practical experience of lowering tolerances shows a major contribution to serious crashes by low-level speeders and significant reductions in deaths when tolerances are reduced. With strong publicity, this is potentially an inexpensive early win;
- **Revise criteria for speed cameras locations.** Criteria should be based on at least the last 2 years of data (not 6 months), should weight fatal and serious injury crashes above other crashes, and should not lead to cameras being removed if safety at the location improves (which generally means the camera is working for Road Safety).

Recommendation 10.3: **Revise speed zoning policy** to address the variability of speed limits for similar conditions by reducing inappropriate limits and the seriously excessive speed limits on some roads. Policy changes should include:

- **Making extensive use of 30 km/h speed limits** (consistent with safe system principles and international best practice) in high use and significant pedestrian casualty crash urban environments. Speeding is a major risk factor in determining injury severity, particularly for pedestrians, with small increases in impact speed producing large increases in probability of death;
- **In urban areas, fix the often inconsistent speed limits** which are primarily designed for traffic flow rather than to manage safety;
- **Include crash rate and severity as key factors in decisions on speed limits**, which should be lowered where significant serious crash records exist, because speed is a factor in every crash;
- **Increase reminder speed limit signs**, to assist driver and rider awareness of limits.

Recommendation 10.4: **Begin implementation of a program of reduced speed limits and increased enforcement in high crash risk locations.** It is important that locations be selected on the basis of two separate criteria- the extent of casualty crashes, and the extent of speeding. However, the identification of speed-related crashes should not be a criterion because these are consistently under-estimated.

Recommendation 10.5: **Revise penalties for speeding**, including:

- **Carry out a full review of penalties for speeding.** Speeding penalties are often not sufficient to deter drivers. A review of penalties for speeding should determine what level of increase is required to redress this problem, and the increases should be accompanied by advance publicity;
- **Escalating penalties** for each repeat offence;
- **A scheme of penalties which allows more sensitivity to the level of the speeding**, in 10km/h increments of increasing consequence;
- **Introducing stronger penalties for speeding by young drivers.** This should form part of the GLS recommended above. Young drivers are largely over-represented in serious (fatal and serious injury) crashes in Brazil. Tougher penalties for young driver speeding are likely to be effective. International research shows that speeding (rather than 'inexperience') is a key contributor to the excessive crash risk of young drivers and riders.

Recommendation 10.6: **Introduce speed cameras which are effective for motorcycles, to address the growing motorcycle safety problem** (see next section). Many existing speed camera programs do not work for motorcycles because the cameras are either front facing or do not record motorcycles. Speed cameras which infringe motorcycles must be introduced, along with a communications campaign noting that motorcycles will be caught by cameras.

Recommendation 10.7: **Enforce truck and buses speed limit compliance with on-board tachographs.** There is currently no enforcement of buses and trucks based on tachographs.

Recommendation 10.8: **Scale-up major communications and paid advertising campaigns in support of extra speed enforcement** to strongly publicize the changes recommended herein well in advance of the changes so that motorists are given reasonable warning of the changes. The campaigns will explain the need and gain public and media support (though the latter is difficult) for the program through understanding of the benefits. However, for effective behavior change the campaign must emphasize the cameras and being fined, not on the possibility of having a crash (more drivers can relate to being fined than the possibility of a serious crash).

Recommendation 10.2 on increased enforcement is suggested for early action due to its strong potential as an early win, though the completion of all the actions of this recommendation will take more time. Communications associated with increased speed enforcement should start in advance of the changed enforcement (part of recommendation 10.8). All other recommendations are medium term though in some cases completion will take a longer period.

## 5.11 AREA OF OPPORTUNITY 11: MANAGEMENT OF MOTORCYCLE SAFETY

Motorcycles represent a major Road Safety risk factor, contributing to serious casualties in Brazil more than any other single road user class. For this reason, motorcycles have been identified as a specific class of road user to be addressed in core recommendations.

**Recommendation 11: The unsustainable<sup>67</sup> contribution to deaths and injury of motorcycles in Brazil must be recognized, and the safety of riders must be addressed.**

Recommendation 11.1: A number of road related actions are recommended to assist motorcycle safety:

- **Creation of motorcycle specific blackspots engineering programs** at federal and state levels to address motorcycle blackspots with treatments which work for motorcycles. These treatments are often different than for other vehicles;
- **Reduce and enforce speed limits on roads** with serious motorcycle crash rates since crashes even at low speed can be deadly for motorcyclists;
- **Increased use of properly signalized speed humps** around serious motorcycle crash locations designed specifically to reduce speeds of motorcycles, including on approach to rural curves. These should be located right across the road width including the shoulders, to avoid motorcycles riding around them on the road shoulder, and designed to slow motorcycles;
- **Examine the feasibility of adding of motorcycle protection on guardrail** barriers where motorcycles have hit the existing guardrail.

Recommendation 11.2: **Create dedicate and compulsory motorcycle lanes** on relevant multi-lane routes with high volume motorcycle traffic.

Recommendation 11.3: **Investigate the feasibility of subsidies to shift riders into cars or subsidized costs of public transport**, based on the huge society costs saved in reducing motorcycle use.

Recommendation 11.4: **Investigate and steadily remove indirect subsidies for motorcycles.** Policy on pricing should consider whole of society costs not just user costs. Motorcycles (the most dangerous and thus costly form of transport to the community) are inadvertently subsidized, encouraging use and thus increasing deaths, injuries and costs to the community. This may occur through compulsory insurance costs being less than real risk (including the costs to society of at fault riders who injury themselves which are not covered in insurance but is borne by society), registration costs being lower than warranted. In net insurance and registration costs should reflect the real cost to the community.

Recommendation 11.5: **Avoid provision of training, especially in schools**, which adds to risk by creating earlier licensing of motorcycle riders, given the evidence for the lack of Road Safety

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<sup>67</sup> Vasconcellos E.A. (2012) Road safety impacts of the motorcycle in Brazil. *International Journal of Injury Control and Safety Promotion*. <http://www.tandfonline.com/loi/nics20>

benefits of motorcycle training<sup>68</sup>. Rider training and rider licensing should be provided at a later age.

Recommendation 11.6: **Require a license to ride a 50cc motorcycle.** The general regulations on driver's licenses in the traffic code are silent on the subject of 50cc. Permission to operate these vehicles is covered elsewhere in the code, where a "municipal license" is established for the purpose. It is recommended that this permission be included the general regulations on ordinary driver's licenses and that tests and mechanisms be established in the Code itself so that the applicant is required to meet certain conditions in order to receive a license (similar to those for other motorcycles). Responsibility for the management of the licensing of 50cc riders should be undertaken through normal licensing processes.

Recommendation 11.7: A number of enforcement related actions are recommended to assist with motorcycle safety:

- **Enforce pressure for motorcycle and two-wheelers registration;**
- **Use technology which specifically targets enforcement of motorcycle speeding** (which is a pervasively observed behavior in Brazil), and reduce the tolerance on speed enforcement of motorcycles to the lowest technically possible minimum on the basis of the large additional risk to motorcyclists (e.g., infringements issued for any speed of 3 or more kilometers above the limit);
- **Enforce the blatant absence of helmet wearing by motorcycle riders in many areas of Brazil, but especially in rural regions.** In many remote areas and rural cities of Brazil visited the large majority of motorcycle riders were not wearing helmets. Enforcement must be sustained until helmet wearing approaches 100%, and failure to see improvement (which should be monitored with helmet wearing surveys, undertaken by the Lead Agency) should be seen as a failure of local Police to undertake the task;
- **Disseminate clear warning messages** at least one month in advance of the above pieces of increased enforcement to ensure riders know these change are coming rather than feel tricked.

Recommendation 11.8: **Adopt a strong Graduated Licensing Scheme (GLS) for motorcycles** in particular for the young. Graduated Licensing schemes provide gradual release from the restrictions of learning towards obtaining a full license, usually over several years. Such schemes have been evaluated and have been found to provide strong reductions in young vehicle controller fatal and injury crash involvements.

The increased focus on enforcement of helmet use in all areas of Brazil (including rural and remote areas) preceded by communications warning of the enforcement (part of recommendation 11.7) are clear early wins for Road Safety in Brazil, and should be progressed as

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<sup>68</sup> Kardamanidis K, Martiniuk A, Ivers RQ, Stevenson MR, Thistlethwaite K (2010). Motorcycle rider training for the prevention of road traffic crashes (Review). *The Cochrane Library* 2010, Issue 10.

a short term action by federal and state police. All other recommendations in this area of opportunity are medium term except recommendation 11.2, which is longer term.

## 5.12 AREA OF OPPORTUNITY 12: MANAGEMENT OF VEHICLES

Safer vehicles (which protect occupants in the event of a crash, and which reduce the risk of crashes through various active technologies, such as electronic stability control) can save many lives and debilitating injuries in Brazil. Yet, vehicles made for the Brazilian domestic market are often of a poorer safety standard than those manufactured in Brazil for international markets.

Recommendation 12: **(a) Facilitate safer new vehicles in Brazil through regulation to higher safety standards, financial incentives, government fleet purchase policy and community education to create demand for safety. (b) Maintain the safety of the existing fleet through safety checks, and incentive schemes to move to newer vehicles.**

Recommendation 12.1: **Regulate for a more stringent vehicle safety standards.** One effective way to achieve this is to harmonize with large vehicle markets by adopting European standards for vehicle safety. This saves complex work in creating separate standards, and maintains a high safety standard, as well as promoting harmonization for flow of vehicle at less cost. The Brazilian vehicle manufacturing industry already produces vehicles to European standards as well as lower safety standard vehicles for Brazil.

Recommendation 12.2: **Brazil should support Latin NCAP,** initiate a program to promote Latin NCAP ratings and car safety to the public and to companies as a key factor in vehicle choice, and ensure that safety rating information is readily available. Latin NCAP ratings should be used in press releases and media events to criticize those producing less safe cars and promote those making safer cars.

Recommendation 12.3: **Adopt standards requiring acoustic seat belt warning in new vehicles for all seating positions,** with a view to significantly increasing the use of seat belts (which is low in Brazil in front seats and even lower in rear seats).

Recommendation 12.4: **Adopt Federal and State and Municipal Government fleet purchase policies for safer vehicles by purchasing only the safest Latin NCAP rated vehicles** in each vehicle use class (sedan, SUV, etc.) in order to:

- Improve safety for government employees, delivering both Road Safety and occupational health and safety gains;
- Send a message to the community that Road Safety matters and that safe vehicle choice will contribute to improving Road Safety;
- Improve the fleet of second-hand vehicles as the government owned vehicles go into the used car market;
- Apply pressure to manufacturers to produce safe vehicles.

Recommendation 12.5: **Examine the feasibility of offering incentives for safer cars, through reduced registration costs and insurance costs** (with commensurate increases in cost for the least safe cars). These fees can also be adjusted to create disincentives for keeping older (less safe) vehicles. Reconsider the current incentives to maintain old vehicles created by existing policies of removal or reduction of compulsory third party injury insurance for older vehicles.

Recommendation 12.6: **Examine the feasibility of regulation for safer heavy vehicles.** Heavy vehicle safety can also be improved via better cabin strength, effective speed limiting, more effective braking systems, more vigilant checking of tachographs for enforcement, and under-run guards to protect occupants of other vehicles in the event of a collision.

Recommendation 12.7: **Continue vehicle safety inspections**, although mechanical failures rarely cause crashes. Parking officers should infringe parked vehicles which are unregistered or have unsafe tires.

All recommendations in area of opportunity 12 are medium to longer term.

### 5.13 AREA OF OPPORTUNITY 13: RECOVERY AND REHABILITATION OF CRASH VICTIMS.

Faster recover and effective treatment of crash victims not only increases the chances of survival but also reduces the risk of long term debilitation of survivors.

Recommendation 13: <b>Improve coordination, cooperation and breadth of coverage of emergency response delivery.</b>
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Recommendation 13.1: **Unify the different emergency numbers for all police, SAMU and the Fire Department into one number** to prevent callers who call the wrong number being referred to another number to call during an emergency, creating confusion and delays. This could be done through a committee with all involved emergency services represented to review and improve collaboration across emergency service providers. Brazil has many emergency numbers including different numbers for state emergency services, for SAMU- national rescue, for Fire Brigade, for Military Police, and for Federal Police.

Recommendation 13.2: **Expand the coverage of emergency helicopter rescue**, which is current well below coverage of the entire country.

Recommendations in area of opportunity 13 are medium to longer term.

### 5.14 AREA OF OPPORTUNITY 14: REDUCED ROAD USE

Significant Road Safety value arises from reduced exposure to road transport by supplying and encouraging use of non-road transport (although care must be exercised to manage the risk of increased speeds in currently congested environments, if congestion reduces).

**Recommendation 14: Include the Road Safety value of alternative transport options when costs and benefits of non-road transport are being assessed, and increase the availability and use of non-road transport for passengers and goods.**

Recommendation 14.1: ***Create long-term communications and education campaign promoting the view that public transport*** as best for society, and a positive means of transport.

Recommendation 14.2: ***Reduce road use and private vehicle use through provision of more services, facilities and policies facilitating adoption of public transport***, engendering the required behavior change, including appropriate incentives and disincentives or regulations such as a car free day and congestion charges.

Recommendation 14.3: ***Create modal shift from road haulage to the use of non-road transport of freight via incentives and other policy options***, and long term planning for improved alternative transport infrastructure.

Recommendation 14.4: ***Undertake economic modelling to evaluate policies and non-road infrastructure development in terms of Road Safety benefits*** as well as other benefits (other economic gains, walking as part of the journey and its health effects, reduced fossil fuel use, reduced noise<sup>69</sup> and air pollution), with non-road policies and infrastructure plans developed based on this modelling.

All recommendations in Area of Opportunity 14 are medium to longer term.

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<sup>69</sup> Noise pollution is often under-estimated as a factor in poor health compared with the evidence for physical and mental health effects: See -WHO (2012) Burden of disease from environmental noise. Quantification of healthy life years lost in Europe. Who: Geneva. and Job, RFS (1996). The influence of subjective reactions to noise on health effects of the noise. *Environment International*, 22, 93-104.

## ANNEX 1 – WORLD BANK GUIDELINES FOR CAPACITY REVIEW

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The World Bank has produced guidelines for implementing the recommendations of the World report on Road Traffic Injury Prevention. Implementing the recommendations requires capacity building at the country level to create the resources and tools necessary to reduce traffic deaths and injuries.

An important first step is to conduct a Road Safety management capacity review to determine the current strengths and weaknesses, and to identify how to overcome capacity weaknesses.

A country capacity review is conducted through nine distinctive steps:

1. Set review objectives.
2. Prepare for review.
3. Appraise results focus at system level.
4. Appraise results focus at interventions level.
5. Appraise results focus at institutional management functions level.
6. Assess Lead Agency role and identify capacity strengthening priorities.
7. Specify investment strategy and identify Safe System implementation projects.
8. Confirm review findings at a high-level workshop.
9. Finalize review report.

High-level country commitment to the review is important for its success. The review must be conducted by experienced internationally recognized Road Safety specialists with senior management experience at country and international level. An inception report to set out the basic elements of the Road Safety management system and to provide available data on Road Safety results and trends is an important first step. A detailed consultation schedule of meetings with key personnel should be drawn up.

The Guidelines include a series of checklists to guide appraisal:

1. Results focus at system level.
2. Planning, design, operation and use of the road network.
3. Entry and exit of vehicles to and from the road network.
4. Entry and exit of road users to and from the road network.
5. Recovery and rehabilitation of crash victims from the road network.

6. Coordination.
7. Legislation.
8. Funding and resource allocation.
9. Promotion.
10. Monitoring and evaluation.
11. Research and development and knowledge transfer.
12. Lead Agency role and institutional management functions.

## ANNEX 2 – LIST OF PEOPLE AND ORGANIZATIONS CONSULTED

Lists are in Alphabetical Order by Institution in Portuguese, then by Name, provided as four separate lists for those who contributed to the National review, and each state level review of Bahia, Rio Grande do Sul, and Sao Paulo. We apologize for any unintended omissions.

Name	Institution
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Hugo Leal	Câmara dos Deputados
Luiz Carlos Kreutz	
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Mauricio Marques	Departamento de Estradas de Rodagem do Distrito Federal (DER/DF)
Henrique Ludovice	
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Alexandre Castro Fernandes	
Lucas de Araújo Bôto	
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Romeo Scheibe Neto	
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Lorena Moreira	
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Jayme Amorim de Sousa	
Emerson Esteves	
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Daniel Mariz	
Luiz Otavio Maciel Miranda (no longer in Denatran)	
<b>Maria Cristina Alcântara Andrade Hoffmann</b>	
Milton Walter Frantz	
<b>Rita de Cássia F. da Cunha</b>	
Ronaldo Camargo	
Rone Evaldo Barbosa	
Alexandre de Araújo Garcia	Instituto Brasileiro de Segurança de Trânsito
Carlos de André Machado	
David Duarte Lima	
Valter Zanela Tani	Laboratório de Transportes e Logística (LabTrans)/UFSC
Elton Santa Fé Zacarias	Ministério das Cidades
Geniana Gazotto Ferreira	
Viviana Simon	

Adriane Cristina Baumann Toschi	Ministério da Justiça	
Celina Pereira		
Marivaldo de Castro Pereira		
Marta S. C. Pordeus	Ministério do Planejamento, Orçamento e Gestão (MP)	
Antônio Barreira	Ministério da Saúde	
Camila Alves Bahia		
Cheila Marina de Lima		
Deborah Carvalho Malta		
Eneida Anjos Paiva		
Karla Larica Wanderley		
Marcia Tubone		
Marta Silva		
<b>Pablo Teixeira de Sousa Leal</b>		
Vívia Belizario da Silva		
Alexandre Euzebio de Moraes		Ministério dos Transportes
Flávio de Moraes		
<b>Francisco Luiz Batista da Costa</b>		
Luiz Carlos Rodrigues Ribeiro		
José Aurelio Ramalho	Observatório Nacional de Segurança Viária (ONSV)	
Paulo Guimarães		
Gabriel Chagas		
Sabrina Viera Sacco		
Anderson Jorge Damasceno Espindola	Polícia Civil do Distrito Federal (PCDF)	
Mauricio Sercheli		
<b>Rossi Farias de Mesquita Júnior</b>		
Antônio Vital	Polícia Rodoviária Federal (PRF)	
Edson Nunes		
<b>Giovanni Bosco Farias di Mambro</b>		
Henrique Fontenelle		
Vinícios Moraes		
Romulo Araujo		
José Lopes Hott Junior		
Julio César Zambom		
Leony Messias		
Maria Alice Nascimento Souza		
Stenio Pires		
Marcos Valério Soares		Polícia Rodoviária Federal - Tocantins (PRF-TO)
Roberto Grangeiro		Prefeitura Municipal de Barbalha, CE
Itamar Sebastiao Barreto	Prefeitura Municipal de Formosa, GO	
Vitor Cosmo Ciasca Neto	Prefeitura Municipal de Fortaleza, CE	
Arcelino Lima	Prefeitura Municipal de Pacatuba, CE	
Marcelo Luma		
DEMUTRANS		
Larissa Brito	Secretaria de Estado de Mobilidade do Distrito Federal (SEMOB/DF)	
José Góes		

André Facó	Secretaria de Infraestrutura do Estado do Ceará (SEINFRA/CE)
Josino Pontes	
Alexandre Guerreiro	Secretaria de Trânsito e Transporte (Palmas)
Divino Ramos	Secretaria de Segurança Pública de Formosa (SSP-TO)
Arthur Trindade	Secretaria de Segurança Pública do Distrito Federal (SSP/DF)
Márcio Mattos	
Welington de Moura Barros	Secretaria Municipal de Acessibilidade, Mobilidade, Trânsito e Transporte (SMAMTT - Palmas)
Marcelo Alves Silva	
Odécio Silva Costa	
Marta Malheiros	
Rodrigo Caselli Belém	
Elias Antônio de Oliveira	
Luis Antônio Tauffer Padilha	
<b>Maria do Socorro Mendes Gomes (Nina)</b>	
Ricardo Bilha Carvalho	
<b>Sonja Maria da Costa Barros</b>	
Luís Fernando Lêdo	Superintendência Municipal de Trânsito de Formosa (SMT-FO)
Victor Pavarino	World Health Organization (WHO) – Former PAHO

#### Road Safety Management Capacity Review – Bahia

Name	Institution	
Anna Christina	Departamento Estadual de Transito da Bahia (DETRAN-BA)	
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Vera Frazão		
<b>José Carlos Rodrigues dos Santos</b>		
Nilton Lima Filho		
<b>Aide Arapiraca da Sila Guerreiro</b>		
Elizabeth Amorim Amoedo Lyra		
Aristide Mattos de Queiroz		
Antônio Martins Morgan		
Anibal Coelho		
Maria Xavier Kalil		Observatório de Segurança Pública da Bahia
Major Arnaldo		
Major Manoilzo		
Sgt. Valdir Viana		
Sub Ten Robson Matos	Policia Rodoviária Estadual (PRE)	
<b>Secretaria de Obras e Serviços Municipais</b>		
<b>Secretaria Municipal de Trânsito e Transporte</b>	Prefeitura de Lauro de Freitas	
Marcus Benicio Foltz Cavalcanti	Secretaria de Infraestrutura (SEINFRA)	
<b>Maria Amelia Pompeu do Amaral</b>	Serviço de Atendimento Móvel de Urgência (SAMU)	
<b>Ivan de M. Paiva Filho</b>		

### Road Safety Management Capacity Review – Rio Grande do Sul

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## ANNEX 3 – THE SAFE SYSTEMS APPROACH

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Humans make mistakes. Even road users (drivers, riders, pedestrians) who are not impaired by alcohol, drugs or fatigue, and are not taking deliberate risks make mistakes that lead to serious crashes. The Safe System approach<sup>70</sup> accepts that people will make mistakes and the road toll will never be solved simply by improving the behavior of road users. Thus, within this approach, the managers of the system (roads, roadsides, vehicles, and people) identify and rectify the major sources of risk or design weakness that contribute to fatal and serious road crashes to mitigate the severity and consequences of crashes. No longer can system operators rely on measures designed to improve the behavior of road users or designed to reduce human error. A key principle is that the road transport system must be designed to accommodate the human failings that lead to crashes, injuries and deaths. Road design and especially roadside protection (such as barriers) must take account of the biomechanical limits of the human body and better manage crash forces down to levels which are not beyond those the human body can withstand, even in the event of human error leading to a crash. This can be achieved for example by determining speed limits that allow the use of the road to occur without death even in the inevitable event of human error. However, this does not mean that road users are no longer to be responsible for their actions or that they can ignore traffic rules, especially speed limits and the need to use seatbelts and helmets.

The principle of shared responsibility underpins the Safe System approach adopted by most countries for reducing crash trauma<sup>71</sup>. This means that system designers are responsible for building safety into the road transport system; and efforts must continue to improve user compliance. System design includes road and roadside design and maintenance, vehicle design and regulation, speed limits, licensing policy, fleet operating policies, new road rules, and land use planning that takes account of safe transport access in decisions on developments such as schools, housing, shopping malls, and developments which draw people. Road Safety decisions should not be taken in isolation but should be aligned with broader community values to which Road Safety is intimately related— economic, environmental, health, equity, and consumer goals. A Safe System approach requires a more coordinated and systematic approach to Road Safety management, and this Review aims to make recommendations that are consistent with this approach.

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<sup>70</sup> ACRS (2010). Fact Sheet: Safe System Approach. Publication of the Australasian College of Road Safety: Canberra. Available at: <http://www.roadsafetytrust.org.au/c/rtt>

<sup>71</sup> For example see: Australian Transport Council (2011). National Road Safety Strategy 2011-2020. Canberra: Australian Transport Council.

**Box: The Safe Systems Approach to Road Safety**

*The safe system approach accepts that human error is inevitable and thus that crashes are inevitable, but does not accept that death and serious injury are inevitable consequences of these crashes. In a safe system, the roads, road sides, vehicles, and speeds combine to limit the kinetic energy to which people could be exposed in a crash to a level which is tolerable by the human body without causing death or debilitating injury. For example, wire rope median and roadside barriers transform severe head-on crashes and crashes into trees and rigid objects into crashes at low impact angles into forgiving barriers.*

The Safe System approach works and has been adopted (under various names) in the most successful Road Safety countries, including Sweden, Netherlands, and Australia.<sup>72</sup> Specific examples of the profound success of applying these principles exist in various projects these countries<sup>73</sup>. Thus, it is also a core element of the World Bank's approach to Road Safety<sup>74</sup>, and the basis of the United Nations Global Plan for the Decade of Action for Road Safety 2011-2020.

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<sup>72</sup> Mooren, L, Grzebieta, R., Job, R.F.S. Williamson, A. (2011). Safe System – International Comparisons of this Approach. *A Safe System- making it happen: Proceedings of the Australasian College of road Safety Conference, Melbourne, September, 2011.* <http://acrs.org.au/wp-content/uploads/Mooren-et-al-Safe-System-%E2%80%93-Comparisons-of-this-Approach-in-Australia.pdf>.

<sup>73</sup> E.g., Carlsson A. (2009). Evaluation of 2+1-roads with cable barrier. Final report. VTI: Linköping, Sweden.

<sup>74</sup> Bliss, A. & Breen, J (2009). *Country guidelines for the conduct of road safety capacity reviews and the specification of lead agency reforms, investment strategies and safe system projects.* World Bank Global Road Safety Facility, Washington, D.C.

## ANNEX 4 – EXAMPLES OF VALUABLE ROAD SAFETY INITIATIVES AND PROGRAMS IN BRAZIL

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Many valuable effective road safety management programs and practices exist in Brazil. Many examples of these (at federal, state and municipal levels of government and by NGOs) are described below in order to highlight that there are programs and policies which should continue and should be expanded. While Road Safety management in Brazil suffers due to the fragmentation arising from management across many states and thousands of municipalities, another (less influential but positive) result of the multitude of Road Safety authorities is that some excellent programs are initiated. Spreading these to more uniform adoption around the country is of value to Road Safety.

### *The Chain is as strong as its weakest link*

Often in Road Safety an entire sequence of processes by various players is required to deliver the final effective outcome. For example, for automated speed enforcement to be effective in providing safety the following processes are necessary:

- The setting of speed limits which provide for safety given the circumstances of the road and its usage;
- Processes to ensure that vehicles are appropriately identified via a registration plate (which in itself requires another enforcement process);
- Effective maintenance of speed cameras;
- Deployment of a sufficient number of speed cameras to allow for a perceived high probability of detection;
- Communications and promotion to ensure that drivers and riders see the probability of detection for speeding as high;
- Holding a low legal tolerance on enforcement, so that drivers know they must stick to the limit;
- Maintaining penalties which actually deters drivers and riders from speeding;
- Timely and accurate processing of images from cameras to send appropriate notices to owners/drivers;
- Processes to ensure on-time payment of fines;
- Processes to prevent avoidance of license penalty points through, for example, non-payment, swapping points to the licenses of others.

In these cases, the chain is as strong as its weakest link: effective camera detection processes by states or DNIT can be limited in effect by small fines which are not sufficient to deter, avoidance or long delay to payment of the penalty, avoiding the license penalties, unsafe speed limits, or

failures in any of the above processes. Thus, it is important that Road Safety management examines and ensures efficiency of the entire sequence of required actions to provide clear Road Safety benefits.

The same risk of the weakest link applies to all areas of enforcement, to the processes for vehicle inspection, accreditation of inspectors, and registration, and to the design, building, and maintenance of safe roads and roadsides.

### *Examples of Good Road Safety Management in Brazil*

#### Examples of Good Road Safety Activities at the Federal level

1. There is vital interest in improving Road Safety in the Federal Government, as evidenced by the Government seeking this World Bank review and the co-operation the World Bank Assessment team have received during the process of preparing it. The President, Dilma Russo, has identified the problems of traffic and safety as a priority in writing and in speeches. This motivation is a critical success factor. (There is, however, some risk that the problem is seen as already being solved on the basis of an apparent annual reduction in deaths for 2013, when in reality there is a long way to go.).
2. The recently added requirement for a rider license to ride a 50cc motorcycle is strongly supported. This is a sound policy to reduce easy and unregulated access to a high risk vehicle.
3. Despite concerns with a number of Federal Highways as described later, there are some well-designed, well-built federal roads. These include the critical features required to provide a safe system: dual carriageways, shoulder and median barriers, grade separated interchanges and overhead pedestrian bridges. For safety, such features must be prioritized over a focus on the surface of the road.
4. There is a clear recognition among Federal Police at national management level and within state regions that speeding is the major cause of serious crashes, and that strong speed enforcement is essential to improving safety. DNIT shares this vision. Federal Police enforcement and DNIT managed camera enforcement of speeding are strong Road Safety programs which warrant expansion. (However, a chain is as strong as its weakest link and the efficacy of these enforcement programs is limited by other links in the enforcement chain, including insufficient penalties to deter, possible mechanisms by which the penalty can be avoided, and long delays in payment of fines. These issues are explored elsewhere in this report.) .
5. Senior Police (and the general audience of Brazilian stakeholders at the International Workshop on Road Safety in Brasilia in November 2014), demonstrated a sound understanding of the key role of enforcement which is a critical point for Road Safety

management in Brazil at this stage, despite the perceived value of education alone in other quarters.

6. Federal Highway Police data are one of the better crash data systems in Brazil and website access to the data is a strong bonus.
7. The Federal Highway Police *Rodovia* campaign is focused on improving Road Safety on federal roads, through enforcement and promotion. Before to after evaluation data presented by Federal Police suggest beneficial effects of this campaign on serious crash risk.
8. Enforcement of drink-driving remains a significant issue in Brazil. However, legislative changes in recent years have been clearly helpful.
9. The staff responsible for DataSUS (the national database within Health which includes victims of crashes) are aware of limitations of the database, especially in terms of missing cases. They are planning improvements to DataSUS to address the problems identified. Such improvement is necessary, though this will be a challenging task requiring ongoing maintenance and management.
10. Development of non-road based transport is an important means of reducing exposure to risk. Less heavy trucks on the road, and less people driving in a broad sense reduces exposure and thus deaths and injuries, though care must be taken in relation to a few side effects of alternative transport, especially including managing the safety of pedestrians where metro and urban rail stations are built and the improved management of speed if urban congestion is reduced. Development of (safer) non-road based transport should be seen as a Road Safety measure in addition to the amenity and other economic, environmental, and social values of such developments. Examples include development of waterways for goods transport, and Federal support for metro systems, the major rail link developments underway in Brazil (see Figure 1). Brazil has a Strategic Waterway Plan<sup>75</sup> to increase waterway use, in addition to already significant water transportation:
  - Brazil has an economically viable inland waterway network of over 22,000 km;
  - According to ANTAQ (National Agency for Water Transports), Brazil transported 38 million tons of freight via inland waterways routes, in the first half of 2014;
  - Brazil has 8500 km of navigable coast;
  - The Brazilian port complex handled 931 million tons of bulk cargo in 2013, an increase of 2.9% compared to 2012.

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<sup>75</sup> <http://www.transportes.gov.br/transporte-aquaviario-relevancia/2-uncategorised/2790-plano-hidroviario-estrategico.html>

**Figure 1. Map of current and proposed rail links to Brazil (Solid lines are existing lines, dashed lines are under construction, projected or planned)<sup>76</sup>.**



#### Examples of Good Road Safety Activities at the State level

1. A number of states have or are negotiating excellent partnerships with the World Bank for road improvement loans with match funding, including funds committed directly to Road Safety (e.g., Bahia, Tocantins, Sao Paulo) and Road Safety Management Capacity Reviews (e.g., Sao Paulo, Rio Grande do Sul, Bahia).

<sup>76</sup> From August 2014 report: [www.antf.org.br/images/2015/informacoes-do-setor/mapa/mapa-ferroviario-brasileiro-agosto-de-2014-m.jpg](http://www.antf.org.br/images/2015/informacoes-do-setor/mapa/mapa-ferroviario-brasileiro-agosto-de-2014-m.jpg)

2. Following a World Bank road safety management capacity review, the state of Sao Paulo is well advanced with the development of an influential Road Safety lead agency with a Road Safety executive group now established in the Governor's office, and the state has developed a strategic Road Safety program for consultation. Plans are also progressing for the development of a more comprehensive crash database to provide an evidence base for Road Safety decisions.
3. While some speed limits on state roads are too high for safety, others are appropriate (such as the 30kpm limits identified on many state roads passing through villages (see Figure 2).
4. Speed humps and transverse rumble strips are an inexpensive and effective way to manage speeding at specific locations on a permanent basis. They are in use in many states of Brazil (Figure 3), and their use should be continued and expanded.

**Figure 2: 30km/h speed limit on a highway through a village in São Paulo State.**



**Figure 3. Example of raised markings/rumble strips in Florianopolis, Santa Catarina and a speed hump in the rural city of Santo Amaro, Bahia, and the warning rumble strips approaching a speed hump in rural Bahia.**



5. State roads in many states have speed enforcement through fixed and mobile cameras and by State Military Road Police. This is good practice by should be substantially expanded.
6. The Road Safety staff met by the World Bank assessment team in many states are very capable (though unfortunately too small in number, and sometimes marginalized from core road development and management decisions).
7. A number of well-designed state highways exist with dual carriageways, grade separations, and pedestrian bridges.
8. Some pedestrian bridges are installed along with pedestrian fencing to prevent pedestrians crossing the road at grade. This is good practice (see Figure 4).

**Figure 4. Median pedestrian fencing at an overhead pedestrian bridge in Bahia.**



9. There are moves in some states to close open roundabouts, creating improved safety at these otherwise high-risk intersection designs.
10. In a few locations excellent off-road bicycle paths exist, such as the one in Figure 5 from Sao Paulo City and Salvador.

**Figure 5. Well executed riverside bicycle path in São Paulo city, and an example from a municipality in Bahia, and a well-patronized temporary bicycle path in Sao Paulo. The last photo shows the problem of bicyclists on busy urban roads where no bicycle path is provided.**

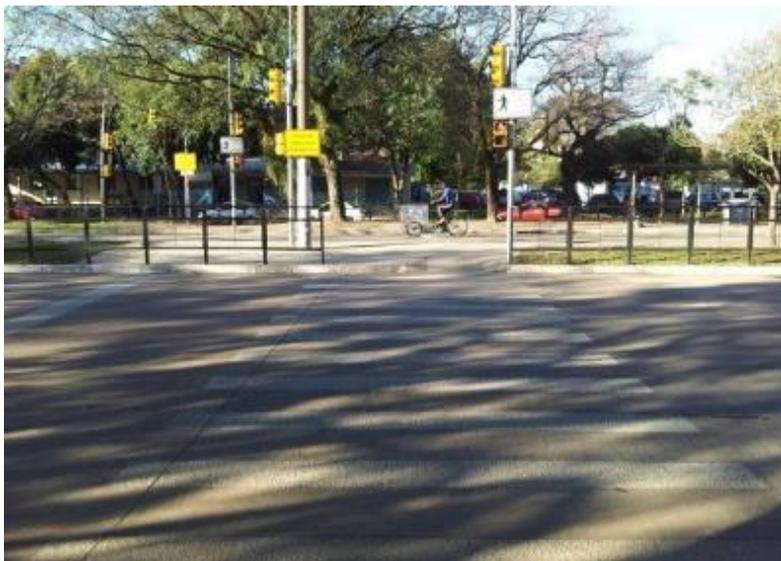


11. Black spot programs to address identified serious crash locations exist in many states, and should be expanded with increased funding and managed with a stronger evidence based approach to location and treatment selection.

#### Examples of Good Road Safety Activities at the Municipal level

1. A number of municipalities run well developed (or developing) speed camera enforcement programs, which are an effective Road Safety intervention (see review of evidence in this report).
2. In a number of cities, whole roads or lanes are closed off from traffic for parts of the weekend for bicycle riding (e.g., Brasilia, Fortaleza, Sao Paulo).
3. There is on-going development of Road Safety activity in some smaller municipalities. For example, Formosa (in the state of Goias) has recently started its own enforcement processes and is planning expansion of these important activities. This approach needs to be expanded to other smaller cities.
4. Many appropriate speed limits exist on Municipal Roads, especially 30kmh and 40kmh limits to protect pedestrians.
5. Black spot engineering programs exist in a number of major city councils (see Figure 6 for an example of a black spot treatment to address pedestrian crashes in Porto Alegre via a designated crossing and pedestrian fencing). These are valuable Road Safety programs which could usefully be expanded.

**Figure 6. Pedestrian fences to channel pedestrians to safer crossing locations are important safety works. This example is part of a successful black spot treatment in Porto Alegre, Rio Grande do Sul.**



6. Several years ago CET (the Road Safety Management section of Sao Paulo city) initiated a program aimed at improving driver culture in giving way to pedestrians at crossings. The program has included extra zebra crossings and crossing guards at crossings in the city (see Figure 7).

**Figure 7: Crossing guards controlling traffic at a São Paulo City crossing.**



#### Examples of Good Road Safety Activities in collaborations across levels of Government

1. Metro systems may be supported at the federal level as well as the municipal level and have been expanded in a number of major cities, reducing road use (such as Proto Alegre, Sao Paulo, Salvador). Other major cities also have metro systems (Belo Horizonte, Brasília, Recife, and Rio de Janeiro) while others are developing light rail transport options.
2. Excellent drink-drive blitzes with strong publicity (see Figure 8) are being run in collaboration between the State Military Police, DETRAN and municipal councils. Continuation of these programs as a regular Road Safety activity is important.

Figure 8. News coverage of Balada Segura in Porto Alegre, 2013.



Examples of Good Road Safety Activities by NGOs and donors

1. The National Observatory is providing important Road Safety data, including publishing its own analyses and commentaries as well as allowing data access for all who seek it via their website. This is an important crash data development for Brazil, despite the limitations of crash data as discussed elsewhere in this report.
2. Some NGOs do work directly with government to improve legislation and regulation (for example, Kidsafe has worked effectively with the National government on regulation of child restraint use for children up to the age of seven and a half years)
3. As noted in the introduction multiple international donor and lending organizations are supporting Road Safety efforts in Brazil, including large loans from the World Bank and other development banks, support from the Bloomberg Family Foundation, for efforts by GRSP, WHO/PAHO, the World Bank, and others.

## ANNEX 5 – DETAILED FINDINGS: CAPACITY FOR RESULTS

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### PLANNING, DESIGN, MAINTENANCE AND OPERATION OF THE ROAD NETWORK.

#### *The Importance of Road Engineering for Safety*

Engineering roads for safety is a fundamental pillar of the safe systems approach to Road Safety, and an essential mechanism by which the most successful Road Safety countries in the world have dramatically reduced deaths and injuries on their roads (e.g., Sweden). The greatest successes have come from improving road sides and preventing head on crashes through the use of well placed and well maintained safety barriers.

The first priority focus must be on preventing death or serious injury in the event of an error, not on assisting the driver not to make an error.

#### *The Situation in Brazil*

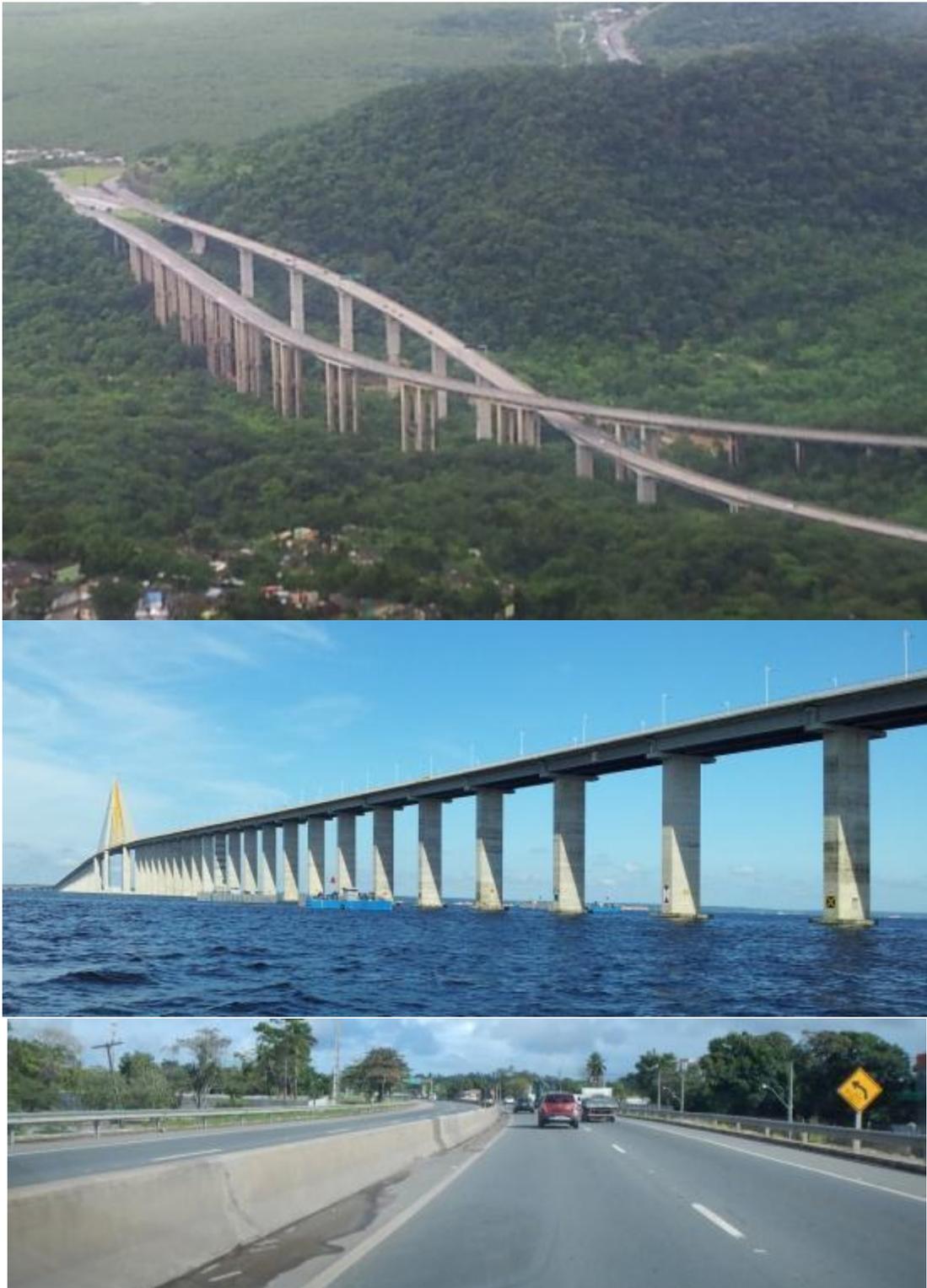
Brazil contains the widest possible range of road quality and design safety, from extraordinary structures to weather dependent poor quality dirt roads, and from effective use of safety barriers to most unforgiving roadsides (see Figure 1 for examples).

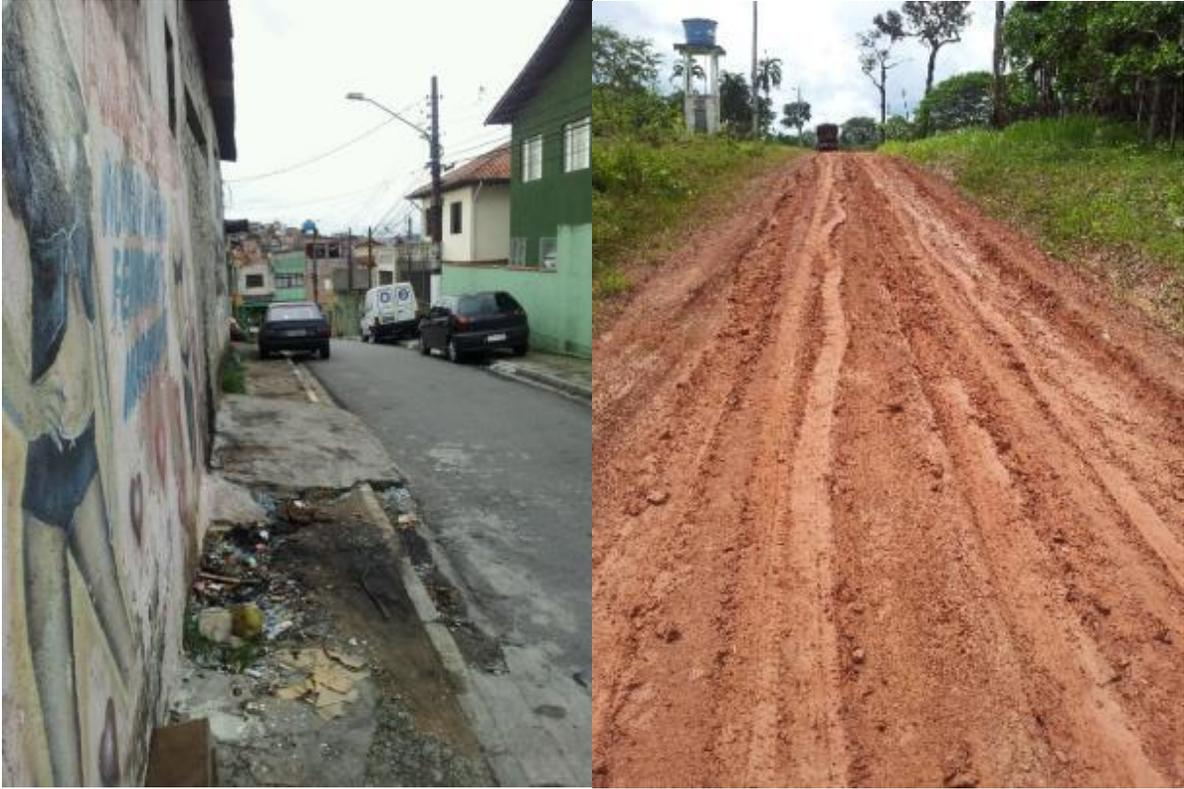
The Federal, State and Municipal road networks are not designed as a safe system. Furthermore, there is no strong movement in this direction in Brazil. A number of factors underlie this slow progress towards safety system road designs:

- A continuing strongly victim blaming culture and presentation is supported by the behavioral focus of publicly promoted Road Safety interventions;
- Safe system principles are not well known and are poorly understood, even in some Road Safety circles;
- Safe systems principles are seen as beyond the financial reach of Brazil;
- As discussed above, the small number of Road Safety staff who have a better understanding of safe systems are typically marginalized and disempowered.

Knowledge transfer is called for to address this situation, including safe systems training, engendering an understanding of the roles of all the pillars of safety (safe roads, safe vehicles, safe speeds, and safe people, combined with sound management), and an appreciation that safe systems can inform Road Safety expenditure even when the funds are limited.

Figure 1. Examples of the range of roads in Brazil (examples from São Paulo, Amazonia, and Bahia).





The consequences of the lack of safe systems thinking in road planning, design, and building are visible on the network and in discussions with organizations. An erroneous strong focus on the road surface rather than the roadsides of high speed roads remains, and barriers are not in common use to create forgiving roadsides. Opportunities for improved safety are considered below, divided into three broad categories: (1) *Road Design and Building*; (2) *Maintenance and Operation*, and in; (3) *Changes in Design Building Maintenance and Operation to accommodate Motorcycles*. Fifteen key opportunities for improved safety are identified under these three headings, with each briefly discussed.

Many opportunities exist for improved road and roadsides for safety of users. The lists below are focused on the particular and most prominent problems identified on the roads of Brazil. These have been chosen based on extensive review of Federal, State, and Municipal roads in many states and on the crash data which identify particular problems which yield major opportunities for improvement. The serious crash data (as reviewed earlier in this report) in particular identify the critical need to address the following issues, which are amenable to changes in road design, building, maintenance and operation:

- Motorcycles are the largest single contributor to road trauma, and must be a point of focus;
- Pedestrians are a significant group of victims of road crashes;
- On rural roads, head-on crashes and crashes off road (including roll-over) are major crash types contributing to deaths and serious injuries;
- Intersections are a key serious crash risk location, with high rates of death for right angle crashes especially.

The analysis of Brazil's Road Safety situation by UMTRI<sup>77</sup> (University of Michigan Transportation Research Institute) identified the following four areas as having potential for substantially reducing fatalities in Brazil: (1) pedestrian crashes, (2) motorcycle crashes, (3) nighttime crashes, and (4) crashes on two-lane roads. This is broadly consistent with above list, except in that intersection crashes have been included above based on right angle crashes only being one type of intersection crash yet that type represents a higher percentage of deaths than most crash types (except head-on and pedestrian crashes included above, and crashes which can occur without the vehicle leaving the road- such as rear-end collisions and lateral collisions). The latter are more difficult to manage via road and roadside engineering and are more effectively addressed through speed management as is the motorcycle issue, which are both considered separately below.

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<sup>77</sup> Vasconcellos, EA Sivak, M. (2009). Road safety in Brazil: Challenges and opportunities. Report No. UMTRI-2009-29 August 2009

## *Opportunities for improved safety in road design, building, operation and maintenance*

### *Opportunity 1: Basic maintenance of safety features on roads.*

Basic maintenance is required (see Figure 2 as an example of this need for Road Safety). However, a focus on the road surface should not be mistakenly seen as providing safety. Good road surfaces often allow faster speeds and thus more frequent and more serious crashes. For safety, specific area of focus for maintenance and the addition of safety features (which do not require major engineering changes to the road) in Brazil are identified below.

**Figure 2. Unsafe poorly maintained highly trafficked pedestrian crossing in São Paulo city.**



### *Opportunity 2: Increased use of barriers (especially wire rope barriers, which are the most forgiving for cars<sup>78</sup>) on roadsides and as median separations to provide a more forgiving road sides in high speed road environments*

On rural roads and highways around Brazil most deaths and serious injuries of vehicle occupants occur through a vehicle leaving its travel lane. The vehicle travels off the road to the right or across the road into oncoming vehicles or fully across the road and off the opposite side.

Reviews of rural roads in many states of Brazil identified insufficient focus on roadsides and median barriers for good Road Safety outcomes, with too much attention paid to the road surface. The causes of most off road and cross-over crashes (excessive speed, fatigue, alcohol, and inattention) will not be significantly addressed by improving the road surface, yet severe consequences will be managed by protecting the roadside and median with safe barriers. In safe

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<sup>78</sup> Barriers are an issue for motorcyclists. See section on motorcycle safety for consideration of this issue.

systems the focus is on what causes the injury or death rather than what causes the crash - as explained earlier this is demonstrably the most successful approach.

Roadside infrastructure, or the lack of it, is critical to crash outcomes, especially on rural roads and highways. Survivability of the consequences of off-road events is largely determined by what the vehicle encounters, and its speed. Trees, poles, drop-offs, rigid objects ditches and slopes which cause rollovers are the most deadly, while wire rope barriers, guard rail and concrete barriers are the most forgiving objects to encounter, in part because of their structure and in part because they run parallel to the road and are thus struck at slight (glancing) angles. Barriers also often prevent roll-over crashes which may occur on non-traversable ground such as ditches or even in clear zones. The latter are of less value than forgiving barriers such as wire rope because of the risk of roll-over, and because the US design standards, often adopted in Brazil, do not allow remotely sufficient clear zone for safety at the speed limits<sup>79</sup>, let alone the actual speeds of travel, on most sealed federal and state highways of Brazil. These unprotected unforgiving objects are common even on reasonably high traffic volume roads, including many sections of the state highway network and parts of the national network (see Figure 3).

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<sup>79</sup> Delaney, A. et al. (2003) Road Environment Safety. Proceedings of the 2012 Australasian Road Safety Research, Policing and Education Conference, Sydney, 2003.

**Figure 3. Examples of unprotected unforgiving objects on highways and urban roadsides- Headwalls, infrangible trees, poles and concrete pillars on roadsides and in medians in the Rio Grande do Sul, Bahia, the Federal District, and Tocantins.**



Barriers cost money to install and, to varying extents depending on the barrier, to maintain. However, there are strong evidence-based reasons for employing a policy of installing roadside

barriers, rather than potentially outdated standards based policy which fails to address roadside hazards or only provides inadequate clear zones:

- benefit-cost ratios are often high, meaning that the savings from reduced deaths and injuries outweigh the costs of barriers;
- Better selection of locations of barriers for real Road Safety gains will reduce deaths and injuries yet keep costs down. Figure 4 shows an example of a poorly located guardrail.

**Figure 4. Extremely short sections of road side barrier along a road in São Paulo with many trees and unforgiving objects near the road.**



- Barriers locations appear to have little regard to the probability of a vehicle leaving the road at that location. For example, we know that vehicles are much more likely to leave the roadway on the outside of a curve rather than this inside. Yet, it is not uncommon to see barriers protecting a small drop on the inside of a curve while the outside of the curve (also with unforgiving objects) is left unprotected;
- Many state and federal highways have no median separation despite the high risk of severe head-on crashes (see Figure 5 for examples). An effective option for separation on these roads which is less costly than dual carriageway is to add a median wire rope barrier. These have delivered major reductions in the road toll of the state of New South Wales, Australia<sup>80</sup>, and are part of the renowned success of the so-called two-plus-one rural roads of Sweden;
- Barriers generally may be made more cost-effective by selective installation at locations with relevant crashes or risks.

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<sup>80</sup>Job, RFS. (2011). Engineering for safe systems: Outcomes of route safety reviews and use of barriers in NSW. Invited guest speaker to *Gulf Traffic Conference*. Kuwait City, March 2011.

There are concerns with employing wire rope (or cable) barriers for safety, especially as median barriers. Yet, experience in a number of countries (Sweden, Australia, and New Zealand, as well as others) shows excellent benefits from wire rope median barriers as well as roadside wire rope and other barriers (see Figure 6 for international examples). In Sweden the massive program of changing large amounts of Sweden’s rural road network to 2+1 roads (roads with wire rope medians barriers, wire rope barriers on both roadsides, 2 lanes in one direction and 1 in the other, with the extra lane swapping regularly to provide overtaking opportunities) has proven to be profoundly successful for Road Safety. Fatal crashes have reduced dramatically, and it is noteworthy that in contrast to media claims of greater risk, motorcycle fatalities have also reducing substantially. In Australia, wire rope median barrier was first used on the Pacific Highway in sections of road which experienced 17 fatalities in the previous 3 years. On those sections there was only been one fatality in the 5 years since the median wire rope barriers were installed. The one fatality occurred when a truck hit the barrier and knocked a section of it down and a few hours later a car crossed the road at the same point over the wire rope lying on the road and rolled on the far side of the road causing a death through an error which would have resulted in a minor crash into the barrier had it not been hit earlier<sup>81</sup>.

**Figure 5. Unsafe medians on Highways in São Paulo, containing non-traversable drains and slopes.**



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<sup>81</sup> Job, RFS. (2012). Applications of Safe System Principles in Australia. *Paper to the 2012 Australasian Road Safety Research, Policing and Education Conference, Wellington, New Zealand, October*

On the positive side, some highways are fitted with median barriers rather than only a median. The team was unable to obtain data on the percentages of federal and state highways which provide the safety of a barrier median.

Unfortunately, this neglect of roadsides even on high traffic volume major roads has also been common international practice, though it is now changing. In contrast with this approach to highway roadside protection, countries with low, or now improving road tolls are adopting stronger median and roadside design protection standards. Thus, the concept of barriers providing fully protected medians and shoulders has expanded from Sweden with great success for Road Safety. Figure 6 shows examples from France, Australia and New Zealand, with full barrier protection. Note that in the photo from Australia, the red painted surface is a bicycle lane and the main roadway is to the left. Roads such as these dramatically reduce (almost eliminate) death and serious injury.

**Figure 6. Examples of fully protected medians and roadsides with barriers, from France, Australia (the red pavement in the bicycle lane, with the main road to the left), and New Zealand.**



Opportunity 3: Increased use of motorway/freeway standard designs with median separation and grade separation of intersections on high speed roads

A number of national highways and some state highways provide some median separation via a grassed median (occasionally also with a barrier). These are valuable safety treatments which minimize (and could fully prevent) cross-over head on crash risk. However, despite the median, the safety afforded by these treatments is often incomplete, which is especially concerning given the funds required to build and maintain these medians. The reason is that these medians are often not sufficiently wide and yet typically contain no barrier, and contain a drain which makes them non-traversable at the speeds of travel witnessed on these roads (see Figure 5 above). Thus a vehicle straying into these medians is likely to suffer a severe roll-over crash. If the errant vehicle does manage to traverse the often rather narrow median the result may be worse because there is then a high risk of a head on crash.

Development of roads to full motorway standard with grade separated intersections minimizes risk at interchanges. However, this full package of treatments is costly and other means of expending Road Safety resources are likely to be more cost effective. However, when the redevelopment of a road is being considered for traffic flow and other reasons, inclusion of the large human, social and economic Road Safety benefits of the development should be considered in decision making.

Opportunity 4: Increased use of (closed) roundabouts on low and high speed roads along with closing of open roundabouts (or “hamburger” roundabouts and “double jug handle” intersections)

Open roundabouts (or “hamburger” roundabouts and “double jug handle” intersections) are a much less safe design than closed roundabouts because the former allow the traffic on one road to travel straight ahead at speed, thus circumventing the key safety gains for roundabouts via forcing vehicles to change direction and slow down. The installation of open roundabouts in Brazil should cease and existing examples (see Figure 7) should be modified to create closed roundabouts. This can be achieved inexpensively with safety barriers and small additional works.

**Figure 7. Open roundabouts are common in Brazil (Source: Google maps).**



Opportunity 5: Provision of safe end terminals on guard rail and concrete barriers

Barriers are sometimes left with unsafe end treatments, which may be extremely unforgiving in a crash (Figure 8).

**Figure 8. Unsafe end treatments on barriers, on highways in various states.**



Opportunity 6: Provision of safe pedestrian amenity, including use of overhead bridges for pedestrians and fencing to exclude pedestrians from accessing the road where overhead pedestrian crossings are provided, more usable urban crossing facilities, regulation to maintain pedestrian facilities, and prevention of high risk encroachments

Pedestrian amenities (safe crossing locations via grade separation or signalized crossing or at a minimum, zebra crossings) improve pedestrian safety. In Brazil, studies by the Civil Police of the Federal District have identified that highways without pedestrian infrastructure and high population density combined with high vehicle flow are key indicators of fatal pedestrian crashes<sup>82</sup>. Even when facilities such as overhead walkways are provided these should be accompanied by well-maintained pedestrian fencing to prevent crossing of the road at grade. Figure 10 provides examples of pedestrian amenity issues in Brazil.

Development encroaching into the road right of way (often right on the roadside) creates high risks for pedestrians. Figure 9 provides an example of shopping stalls fronting the road at the location of a recent fatal pedestrian crash. Nighttime visibility is also a significant safety problem for pedestrian safety.

**Figure 9. Illegal stall fronting the road in a rural town in Bahia.**



Additional challenges for pedestrian safety are the absorption of pedestrian facilities by other activities (shops, construction, etc.) and the absence of footpaths (see Figure 11 for examples).

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<sup>82</sup> Telles B et al. Analysis Of Environmental Criminology Of Pedestrian Crashes In Federal District, Brazil.  
Sercheli MS et al. Environmental Criminology Based Analysis Of Motor Vehicle Traffic Collisions Occurred In The Federal District, Brazil

**Figure 10. Examples of issues with pedestrian amenities in various states of Brazil.**

- a. Pedestrians crossing near facilities, due to lack of pedestrian fencing and poor location of bus stops.



- b. Pedestrians waiting in the median for the second phase of the lights before being allowed to cross or disobeying the “don’t walk” signal at different locations



- c. A removed section of pedestrian fencing at an overhead pedestrian/cycle crossing allows a cyclist to cross on the road



Figure 11. Pedestrians forced to walk on roads and roadsides due to lack of pedestrian sidewalks or encroachment onto them by construction, light industry, or shops.



Opportunity 7: Sealing of roads shoulders and at least including the existing shoulder in maintenance and resealing works, to avoid a drop between the new and old road surface at the shoulder, which could destabilize vehicles especially including motorcycles or bicycles, and should often include widening the shoulder.

Many highways with high speed traffic and smooth travel surfaces provide no sealed shoulder to allow for drivers to correct errors, and provide a safer location for bicycle riders and other slow moving traffic (such as animal drawn vehicles) which are not uncommon on rural roads in Brazil (Figure 12).

**Figure 12. The absence of a sealed shoulder also adds greatly to serious risk for cyclists and other slow road users (such as animal drawn carts) forced to ride in the main travel lane on a high speed rural and urban roads in Brazil.**



The risk of many of these roads is also increased for drivers and riders by often narrow or non-existent sealed shoulders allowing even an alert driver who had made a mistake of been forced off the road by oncoming traffic, minimal time to correct- the photo with the trees in Figure 3 provides an example.

In many cases these highways also have minimal sealed shoulder, leaving drivers little room to escape in the event of their own error or in the event of a vehicle crossing the centerline. Figure 13 shows a major head-on crash witnessed on such a highway during the review.

**Figure 13. A major head-on crash on a São Paulo State Highway with no median separation or sealed shoulder.**



*Opportunity 8: Maintain unsealed shoulders or seal unsealed shoulders to prevent the erosion of the shoulder and the creation of a drop at the edge of the seal.*

Figure 14 provides examples of roads with significant drops on unsealed shoulder or resealing of the road surface without resealing the shoulder also creating a drop, of risk to two-wheeled vehicles.

**Figure 14. Roads with significant drops on unsealed shoulder or resealing of the road surface without resealing the shoulder also creating a drop, of risk to two-wheeled vehicles.**



Opportunity 9: Wider use of profile line marking or rumble strips to improve delineation and reduce off road crash events.

Evidence shows that profile line marking or rumble strips reduce off road crash events, especially at night by providing better delineation and by alerting a fatigued driver<sup>83</sup>. These should be employed more in Brazil where relevant serious crash patterns exist.

*Opportunities for improved safety in accommodating motorcycles*

The importance of motorcycles to Road Safety

Motorcycles represent a major Road Safety risk factor, contributing to serious casualties in Brazil more than any other single road user class (see earlier analysis). Studies in countries and states with rigorous data show that motorcycles have around 20 times the death rate of cars on a per kilometer of travel basis. This is not surprising, given the dramatic lack of protection offered by the vehicles in a crash compared with a car, and the added risks of instability and falling arising from the vehicle having only two wheels.

Opportunity 1: Separate motorcycle lanes and regulate to make the use of these lanes mandatory for motorcycles.

High risk lane splitting at high speed is common by motorcycles in a number of major cities of Brazil though none worse than Sao Paulo. On multi-lane roads with large numbers of motorcycles, dedicated and mandatory motorcycle lanes should be considered, along with an effectively enforced ban for cyclists or pedestrians.

Opportunity 2: Maintenance of road surfaces and shoulders to avoid hazards for motorcycles.

Uneven surfaces create risk for motorcycles (see earlier Figure 14 for examples).

Opportunity 3: Motorcycle “skirts” on wire rope barriers.

Although wire rope barrier does not work as a “cheese-cutter: as sometimes naively claimed, the posts are significant risk to motorcyclists (as are the posts on guardrail). Motorcycle skirting or

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<sup>83</sup> Job, RFS & Hatfield, J. (2002). Review of the Evidence for Profile Line Markings as a Road Safety Countermeasure: I. A revised cost-benefit analysis for rural roads. *Roadwise*, 13 (4), 16-18.

post cushions exist to reduce risk for motorcyclists and should be considered especially where motorcycle risks and exposure are high.

*Opportunity 4: Better management of the risks of animals on roads.*

The state road authorities in some states collect animals from the roadway to prevent serious crashes into animals (especially at night). These can result in especially serious or fatal crashes for motorcyclists. However, these animals once captured are maintained on farms at significant expense due to inability to destroy or sell the animals. It is recommended that this inability to dispose of unwanted animals be resolved by allowing that the animal may be humanely destroyed or sold for other uses, after a short time in which the owner can (for a fee) collect the animal. This would allow expansion of the program and yet reduce net costs.

## MANAGEMENT OF VEHICLES ON THE ROAD NETWORK.

Safer vehicles (which protect occupants in the event of a crash, and which reduce the risk of a crash through various active technologies, such as electronic stability control) can save many lives and debilitating injuries in Brazil. Vehicles with better crash protection save both lives and serious injuries.

*Opportunity 1: Better regulation for vehicle safety standards.*

The World Bank assessment team was informed that Brazilian vehicle manufacturing industry already produces vehicles to European standards as well as lower safety standard vehicles for Brazil. There is little regulation of manufacture or import, allowing vehicle manufacturers in Brazil to produce safer vehicles for external markets and sell lower safety vehicles in the Brazilian domestic market. This should be addressed.

*Opportunity 2: Review policies on pricing of older vehicles.*

In some states (e.g., Goiás) vehicle owners pay for LIDER DPVAT insurance for 10 years then insurance is free. This encourages old vehicles less safe vehicles, the exact opposite policy to successful policies in other countries for removing the oldest poorest standard vehicles by rewarding the removal of old vehicles (in 'cash for clunkers' programs) not rewarding the retention of old vehicles. These policies should be reconsidered in Brazil.

*Opportunity 3: Better enforcement of vehicle standards and owner responsibility.*

Vehicle confiscation is limited by lack of storage and thus Police are unable to take vehicles as allowed by law (See the box on Formosa for more detail).

## MANAGEMENT OF ROAD USERS ON THE ROAD NETWORK.

Many critical process and behavioral issues are identifiable from on-road observations in Brazil (especially remote and rural areas) and from the crash data and research evidence. A list of these (with each presenting opportunities for improved safety) is provided below:

- Speeding is the largest contributor to serious crashes, and is addressed in a separate section below;
- Motorcycle helmet use is the norm (though not uniform) in major cities, but helmet use is less common in remote and rural areas of Brazil (Figure 16). Failure of helmet use (or improper usage such as the helmet being worn on top of the head not strapped on- Figure 16) is a significant contributor to Brazil's unsustainable motorcycle trauma problem;

**Figure 16. Absent and sometimes incorrect motorcycle helmet wearing especially in rural Brazil.**



- Seat belt non-use is common (especially compared with the best performing countries which are reaching 99% usage rates). Figure 17 shows an example of driver in Brazil who has fitted a clip to the seat belt to prevent it from retracting so that it appears to be worn but is not buckled up and people riding on the top of a load on a truck on a public road. The evidence for the safety value of seatbelts is irrefutable;
- Child restraint usage rates are poor, with children often observed traveling in vehicles being nursed, sitting unrestrained, or even standing. Usage is critical to safety;

**Figure 17. A driver in Brazil who has fitted a clip to the seat belt to prevent it from retracting so that it appears to be worn but is not buckled up.**



- Helmet use by cyclists is a rare sight in Brazil, which contributes to serious injury risk (Figure 18);

**Figure 18. Non-use of bicycle helmets is the norm in Brazil.**



- Dangerous road use by pedestrians is facilitated or forced by poor or absent facilities (see earlier section) but is also a behavioral issue which should also be addressed as such (though often there is also fault with the driver or rider). See Figure 19 for examples of high risk pedestrian use of the road at night in Manaus, Amazonia and by road maintenance workers working unprotected on a high speed road;
- Fatigue driving is a significant safety issue.

**Figure 19: High risk pedestrian use of the road at night in Manaus, Amazonia**



These behavioral issues are underpinned by a number of key behavior change management limitations in Brazil, which include:

- Legal impediments to effective enforcement processes;
- Coordination impediments to effective enforcement (see section above);
- Ineffective promotional campaigns which are focused on high fear crash events and consequences rather than enforcement;
- The limited risk of detection by Police;
- The possibility of avoiding the penalty if detected;
- Weak penalties which will not deter many drivers;

- Inadequate focus of Police on specific issues. If local enforcement were active the high and patently visible rates of non-use of motorcycle helmets witnessed in rural areas would not occur.

Enforcement issues and the importance of minimizing punishment avoidance for Road Safety.

The 2013 Global Status Report<sup>84</sup> made the following ratings (out of 10) of Brazil's enforcement relevant to a number of the issues identified above:

- Speed 6/10;
- Drink-driving 6/10;
- Motorcycle helmets 7/10;
- Seat belts 6/10;
- Child restraints 6/10.

**Specific Deterrence** is the extent to which a person is deterred from doing a certain action (such as speeding, running a red light) because they have been caught and penalized for that behavior. The more people who are caught, the more people who are affected by specific deterrence. The effects of specific deterrence are enhanced by the threat of increasing penalties for repeat offences. Therefore, getting caught can increase deterrence because the penalties for getting caught again will be more severe. For example, many penalties increase for repeat offences (such as drink-driving), and the demerit points scheme makes the threat of license loss more possible with any offence carrying points.

**General Deterrence** is extent to which people are deterred from doing a certain action, not because they have been caught, but because they believe they may be caught and the consequences of being caught are undesirable. Thus, people avoid the behavior in the first place, and this is a key benefit to Road Safety. To get the best possible benefits from enforcement we must maximize both specific and general deterrence. Effective enforcement and communication programs must take into account the active avoidance response of drivers and road users, who are not passive recipients of enforcement.<sup>85</sup> Drivers respond to enforcement and punishment by:

- Actively avoiding places where they know they might be detected;
- Actively modifying their behavior only when there is a risk of detection;
- Actively modifying their behavior when they see Police activity (enforcement is a cue that produces a temporary change in behavior);

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<sup>84</sup> WHO (World Health Organization) (2013) *Global status report on road safety 2013: Supporting a decade of action*. WHO: Geneva

<sup>85</sup> Harrison, W.A, Newman, S., Baldock, M, & McLean, J. (2003) *Drink-Driving Enforcement; Issues in Developing Best Practice AP-R220*. Sydney: Austroads.

- Letting others know when and where they have been caught offending and where and when they see police activity and automated enforcement;
- Making appeals to more senior police or otherwise trying (sometimes successfully) to have a penalty reversed.

Successful punishment avoidance experiences greatly damage both specific and general deterrence. Specific deterrence is damaged because the successful avoider is not caught, and general deterrence is damaged by the belief that enforcement can be avoided with the same tactics in the future. The effect can spread by the avoider telling others how to do it. Rumors and/or beliefs that avoidance is possible can harm general deterrence regardless of how correct they are. These must be managed through strong enforcement practice which minimizes avoidance combined with communications to the community and the media showing how enforcement practice is overcoming avoidance behaviors.

There are approximately 9,800 Federal Police, with 7,000 on active enforcement duty, which is about the same number as 20 years ago. Increased enforcement, especially dedicated to Road Safety, would be of assistance on federal, state and municipal roads.

### Drink-Driving

While drink-driving enforcement has been improved by recent national legislative changes, problems remain. Despite a low alcohol limit and apparently strong penalties, drink-driving may remain a significant problem. Some Military Police report that they enforce a limit of .06 g/l Blood Alcohol Content (BAC). Sound data on drink-driving in crashes do not appear to be available to monitor the issue and the enforcement and monitoring of drink-driving remain problematic. In addition, knowledge of the BAC limits and consequences is poor after the move to a zero BAC limit in Brazil<sup>86</sup>, but may have improved recently.

Deep-rooted legal/civil rights/constitutional challenges to the legal basis of drink-drive testing exist, though serious attempts to address this have occurred at a national level. Improvement has been achieved, as can be seen from the numbers of people charged with drink-driving (including use of other substances, though the large majority of these offences are drink-driving). As an example, below are the numbers of drivers charged in each year in Sao Paulo<sup>87</sup>:

- 2009: 1,863;
- 2010: 2,602;
- 2011: 6,225;
- 2012: 13,263.

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<sup>86</sup> Conceicao, T et al. (2012) Awareness of legal blood alcohol concentration limits among respondents for a national roadside survey for alcohol and traffic behaviors in Brazil. *International Journal of Drug Policy*, 23, 166-168.

<sup>87</sup> Source: Sao Paulo Military Police and SLT

These numbers show an encouraging increase since new national laws were passed, indicating the barriers to testing are being overcome. However, the current enforcement situation remains far from ideal. A driver is able to refuse the breath test, leaving the Police officer in the position of having to obtain two witnesses that the driver is drunk in order to obtain a conviction. Apart from the logistical difficulties this creates, it also encourages the view among drivers that a conviction can be avoided if they do not appear drunk to witnesses.

However, these enforcement numbers are small (especially on a per license basis, compared with states in other countries which operate strong drink drive enforcement programs). With a stronger legal basis for testing, Police capacity to test must be improved and random breath testing fully embraced in order to capture the Road Safety gains available. São Paulo Military Police have 131 active and passive alcohol test devices, compared with much larger numbers of test devices on a population basis for jurisdictions which have managed great improvements in their road tolls via large programs of random breath testing. For example, New South Wales (NSW), Australia, has been especially successful in long term management of random breath testing which has reduced the alcohol related road toll dramatically<sup>88</sup>. Police in NSW have 2000 alcohol screening devices and 320 evidentiary standard devices<sup>89</sup> at their disposal and conducted 4.5 million breath tests in 2012<sup>90</sup>, in a state of 4.9 million licensed drivers and riders.

The driver's right to refuse to take the breath test is likely to remain despite the impediments to deterrence, increased death and injury it creates. Recently revised legislation allows Police to charge a driver who refuses the breath test with drink-driving via a witness. The problem for general deterrence is that drivers who are over the legal limit (now zero BAC) and impaired by alcohol but who believe that they do not look or act in a manner which demonstrates they are drunk are not likely to be deterred from driving by the law because they feel they are not detectably drunk. Indeed for most drivers with even a moderate tolerance for alcohol the BAC level at which they will appear drunk is well above the legal limit, even though their driving is impaired by any amount of alcohol. If driving cannot be seen as a privilege for which certain searches and tests are warranted (analogous to a security check to enter the parliament), then the penalty for driving drunk (as attested to by witness) should be made a great deal higher than the penalty for being over the legal limit even by a large margin. This is justified on the basis that to be visibly impaired is a severe level of drinking regardless of the BAC at which this occurs, and

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<sup>88</sup> Job, RFS, Prabhakar, T., & Lee, S.H.V. (1997). The long term benefits of random breath testing in NSW (Australia): Deterrence and social disapproval of drink-driving. In C. Mercier-Guyon (Ed.), *Proceedings of the 14th. International Conference on Alcohol, Drugs and Traffic Safety, Annecy, 1997*. (pp. 841-848), France: CERMT.

<sup>89</sup> Personal communication from Assistant Commissioner John Hartley, NSW Police

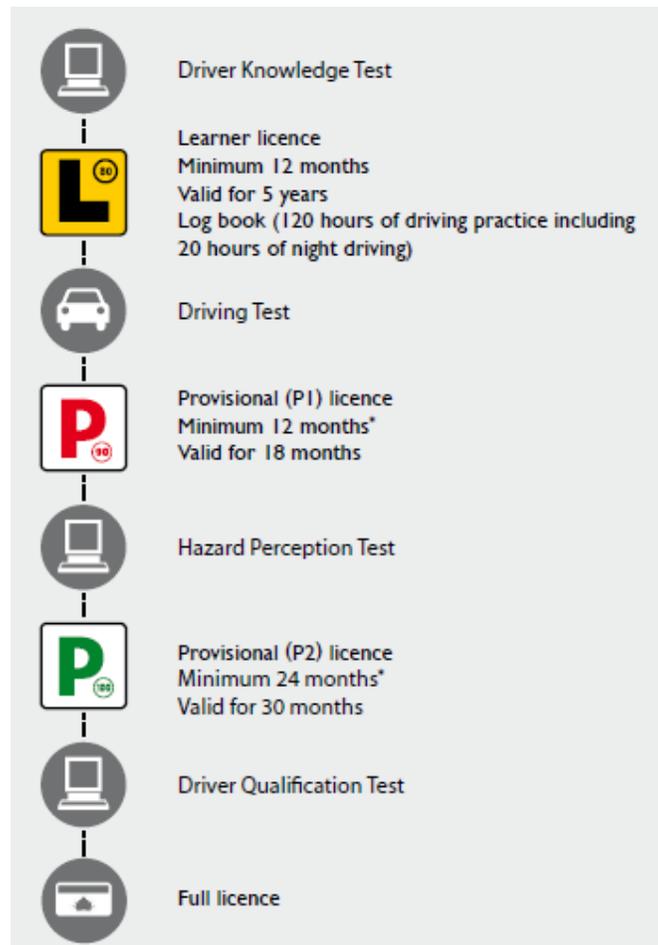
<sup>90</sup> Source: <http://www.rta.nsw.gov.au/roadsafety/alcoholdrugs/drinkdriving/index.html>, accessed April 2013.

thus the offence is much more serious. This change in law, along with strong publicity on it, will actively discourage drivers from refusing the test and add to the deterrence value of drink-driving laws.

### Young Drivers

Graduated license schemes are well established to reduce the risks of young drivers. As an example of such a scheme, see Figure 20, which shows the tests and four stages of gradual release of constraints towards a full license in New South Wales, Australia. Similar schemes exist in other states and countries and have been shown to reduce young driver serious crashes and deaths.

**Figure 20. An outline of the graduated licensing scheme in place in New South Wales, Australia.**



Following research showing over-representation of young drivers in serious speeding crashes<sup>91</sup> changes were made to novice driver license conditions in NSW including that any speeding offence by a Provision 1 (P1) driver would result in loss of license for 3 months in addition to other penalties. This produced an immediate 34% reduction in speeding fatalities involving Provisional 1 drivers.<sup>92</sup>

Such a graduated license scheme, if properly implemented and enforced, will result in reduced deaths and injuries caused by young drivers.

## MANAGEMENT OF TRAVEL SPEEDS ON THE ROAD NETWORK

### *The critical role of speeding in road trauma*

Speeding is correctly recognized as the largest single behavioral contributor to road deaths globally, and this is also true of Brazil. Speeding is the key factor in road related trauma as identified in best quality research and reviews<sup>93</sup> including by world leading authorities: the World Health Organization, World Bank, and Global Road Safety Partnership<sup>94</sup> as well as the OECD<sup>95</sup>.

A common misunderstanding is that speeding increases the severity of crashes, but does not cause crashes. Speeding contributes to the occurrence of crashes in a number of ways as well as contributing to the severity of the crash through: reducing capacity to stop in time; reducing maneuverability in evading a crash; making it impossible to negotiate curves and corners at speeds above those which simple physics will allow for the friction available; and causing others to misjudge gaps, for example by allowing pedestrians less gap to cross the road than expected because the vehicle is travelling above the speed limit.

Furthermore, in official figures speeding is generally underestimated as a factor in fatal and serious crashes. This claimed under-estimation in official figures is demonstrated by the effects of speed cameras in other countries. For example, official estimates (based on Police reports) indicated that speeding contributed to around 35 to 40% of fatal crashes in the state of New South Wales (NSW, the most populous state of Australia), yet the independent evaluation of the

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<sup>91</sup> Sakashita C, Graham A, de Roos M, Croft S, Elliot M. (2007). "Comparing provisional and unrestricted licence holders on speeding offences and crash rates." Paper in Proceedings of the *Australasian Road Safety Research Policing and Education Conference*, Melbourne, 17-19 October 2007.

<sup>92</sup> Job, RFS. (2013), *Pillar 1 Road Safety Management – Speed management*. Paper to the Transportation Research Board Annual Meeting- TRB Sunday Workshop: Pivotal Role of Speed Management across the Five Road Safety Pillars; Washington DC, January 2013.

<sup>93</sup> Nilsson, G. 2004. *Traffic Safety Dimension and the Power Model to describe the Effect of Speed on Safety*, Lund Institute of Technology, Sweden.

<sup>94</sup> Global Road Safety Partnership (GRSP/WHO) 2008. *Speed Management: A road Safety Manual for decision makers and practitioners*. WHO/GRSP, 2008

<sup>95</sup> OECD (2006). *Speed Management. Report of the Transport Research Centre*, ECMT Paris.

NSW fixed speed cameras revealed that at treated locations, the cameras resulted in a 71% reduction in speeding and an 89% reduction in fatalities<sup>96</sup>. Because speed cameras only address speeding as a crash factor, these results suggest that speeding was contributing to most fatalities (at least 89%) not merely 35 to 40%. Evaluations of point-to-point (or section control) cameras in Europe has revealed similarly dramatic reductions in serious crashes when speeding is managed.

### Speeding in Brazil

Travel speeds commonly remain excessive, and are a key contributor to both crash occurrence and severity. Part of the reason for this is the high tolerance which is accepted above the speed limit before drivers are penalized for speeding along with the low probability of being caught. Thus, engineering works are required to reduce speeds at many locations. Simply getting motorists to obey the speed limits would save many lives in Brazil.

Police officers in Brazil agree that official figures result in an under-estimate of the problem, with some estimating that speeding is a key factor in as much as 80% of fatal crashes. Speeding is readily observed on roads throughout Brazil, and this has been confirmed by a survey of speeds conducted in the state of Bahia for the Bank's assessment there.

### Speed Surveys in Bahia

Following the observation of cases of excessive speeding by the World Bank assessment team, a small on-road objective speed survey was conducted for the World Bank team by State Military Road Police. The study was undertaken in daylight on rural Highways BA262 and BA263 to check speeding. Police placed radars at several locations along these highways in 80km/h and 40km/h speed limit zones. The speed surveys confirmed a serious speeding problem on both highways: In the two locations on 80km/h zones excessive speeds were common: in a few hundred vehicles the following speeds were recorded: 147, 136, 130, 111, etc. For one of these locations the average speed of identified vehicles was 98km/h (18km/h above the limit). In 40km/h zones, many instances of speeds over 70km/h were observed, and for one of these locations speeds average 69km/h (29km/h above the speed limit). Such speeds are major contributors to crash occurrence and severity, and cannot be allowed to continue.

### The success of speed cameras and other treatments in reducing the road toll

The success of speed cameras in reducing road deaths and serious injuries is irrefutable. Two practical examples of government management of speed cameras from Australia support the

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<sup>96</sup> Job, RFS. (2012). Applications of Safe System Principles in Australia. *Paper to the 2012 Australasian Road Safety Research, Policing and Education Conference, Wellington, New Zealand, October.*

broad international reviews of evidence cited above. In the state of New South Wales, as noted above, independent analysis of the fixed speed camera program showed huge benefits at camera locations: speeding down by 71%, fatalities down by 89%, and injuries down by 20%.<sup>97</sup> Second, Police discontinued using mobile speed cameras in NSW and the cameras were not re-implemented until the NSW Centre for Road Safety was allowed to take over the program over a year later, after a large increase in the road toll. When the cameras stopped operation deaths rose by 21% and when the cameras were re-introduced the next year the deaths decreased by 11% but took another year to return to lower levels than before the cameras were discontinued.<sup>98</sup> Speed camera enforcement has been shown repeatedly to reduce the toll of deaths and injuries<sup>99</sup>. Numerous studies have been reviewed by the OECD<sup>100</sup>, and by the Cochrane Library Review,<sup>101</sup> both concluding that the evidence shows that speed cameras clearly provide substantial Road Safety gains in terms of reduced deaths and injuries.

Fixed and mobile speed cameras are in use on federal highways, state highways and in some municipalities (Figure 21). However, federal requirements for visibility and signage (Figure 22) of cameras limit the cameras to primarily operating as location specific treatments rather than being able to provide a broader suppression of speeding across the network, which is preferable. Research has shown that generally drivers slow for signposted or visible cameras and speed up after they pass them.

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<sup>97</sup> Job, RFS. (2012). Applications of Safe System Principles in Australia. Paper to the 2012 Australasian Road Safety Research, Policing and Education Conference, Wellington, New Zealand, October.

<sup>98</sup> Job, RFS. (2013). Overcoming barriers to effective management of Speeding. Paper to Australasian College of Road Safety Seminar: A Culture of Speed. Canberra, March 14, 2013.

<sup>99</sup> For example:

Cameron, MH, Cavallo, A & Gilbert, A. (1992). Crash based evaluation of the speed camera program in Victoria 1990-1991. Report 42. Monash University Accident Research Centre, Victoria Australia.

Job, RFS. (2012). Applications of Safe System Principles In Australia. Paper to the 2012 Australasian Road Safety Research, Policing and Education Conference, Wellington, New Zealand, October.

Keall, MD., Povey, LJ. & Frith, WJ. (2001) The relative effectiveness of a hidden versus a visible speed camera programme. *Accident Analysis & Prevention*, 33, Issue 2, 1 March 2001, Pages 277–284

Gains A, Heydecker B, Shrewsbury J, Robertson S. The national safety camera programme -Three-year evaluation report. Department of Transport. Road Safety Division. London UK 2004:1–110.

<sup>100</sup> OECD. (2006) Speed Management. Report of the Transport Research Centre, ECMT Paris.

<sup>101</sup> Wilson C, Willis C, Hendrikz JK, Le Brocque R, Bellamy N. 2010. Speed cameras for the prevention of road traffic injuries and deaths. *Cochrane Database of Systematic Reviews*, Issue 11

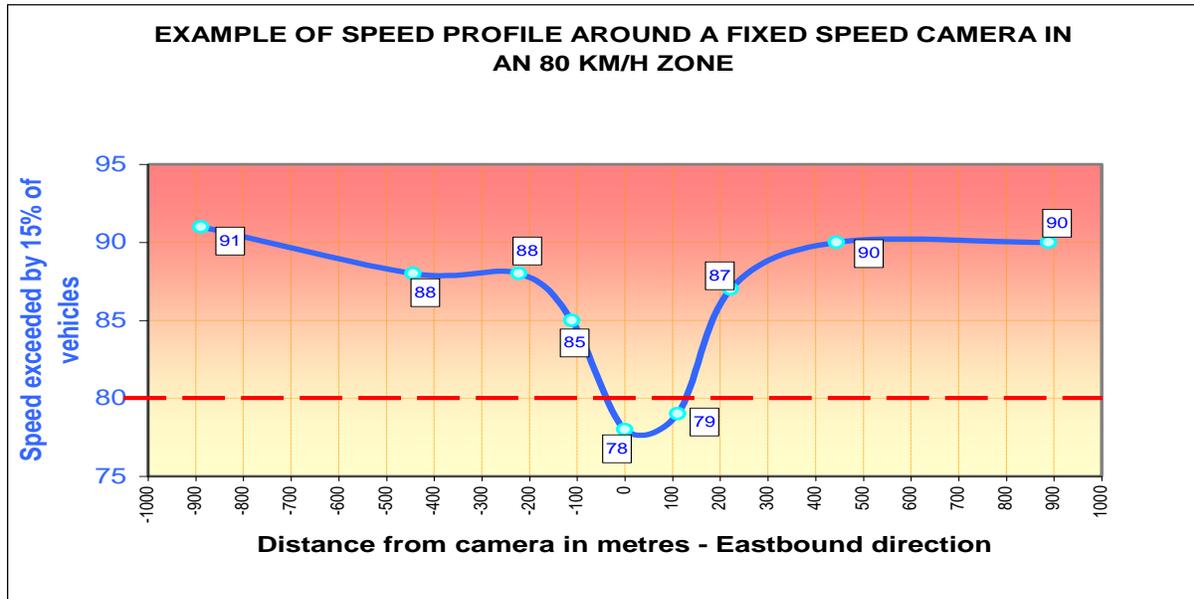
Figure 21. Static (moveable) and fixed cameras in São Paulo state.



Figure 22. Extensive speed camera warning signs on urban and open roads in Brazil.



Figure 23. 85<sup>th</sup> percentile speeds recorded on approach and departure around a sign-posted speed camera in in an 80km/h speed limit in New South Wales (Australia), showing the limited extent of effect of this approach to speed enforcement.



Signposted speed enforcement slows drivers down for around 600 m (see Figure 23 for the results of a study of the effects of a signposted speed camera in the state of New South Wales, Australia<sup>102</sup>). Applying this finding of speed camera effects for about 600 m to Brazil, in which speed cameras are typically sign-posted, means that only a tiny proportion of the road network is effectively enforced for speeding.

In many instances, the fixed cameras are not in themselves highly visible which is an excellent feature encouraging broader suppression of speeding. Mobile cameras operate without signage, providing a balance to the signage around fixed cameras, though this is somewhat limited in effect by the requirement for visibility. In addition, penalties are sometimes avoided and are not sufficient to deter many drivers.

Speed limits in Brazil are also too high for the road usage occurring in many instances and should be reviewed. Although speed limits on rural roads are generally either appropriate or not far from appropriate for the environments in which they exist (with a few exceptions), travel speeds commonly remain excessive, and are a key contributor to both crash occurrence and severity.

Finally, it is important to employ road engineering treatments for speed management and to retain existing treatments such as speed humps and cobblestones which reduce traffic speeds.

<sup>102</sup> Job, RFS. (2013), *Pillar 1 Road Safety Management – Speed management*. Paper to the Transportation Research Board Annual Meeting- TRB Sunday Workshop: Pivotal Role of Speed Management across the Five Road Safety Pillars; Washington DC, January 2013.

This can include transverse rumble strips, speed humps which should be used more as an effective treatment, gateway treatments, and other devices (for examples see Figure 24).

**Figure 24. Effective speed reduction device in Anhembi city, São Paulo state, and cobblestones in Bahia.**



There is little results focus on speeding in Road Safety management, with no apparent intermediate outcome measures in use for monitoring. Within senior Police and some areas of government (including DNIT) there is a sound appreciation of the need for speed enforcement and speed management generally. However, more broadly in the community and among many government officials there is insufficient appreciation of the role of speed in serious crashes, and speeding continues to be normal and accepted behavior on the roads of the country.

It is important to appreciate that higher speeds are not simply better for the economy, because the costs of crashes, injuries, pollution, and fuel all increase.

## RECOVERY AND REHABILITATION OF CRASH VICTIMS FROM THE ROAD NETWORK.

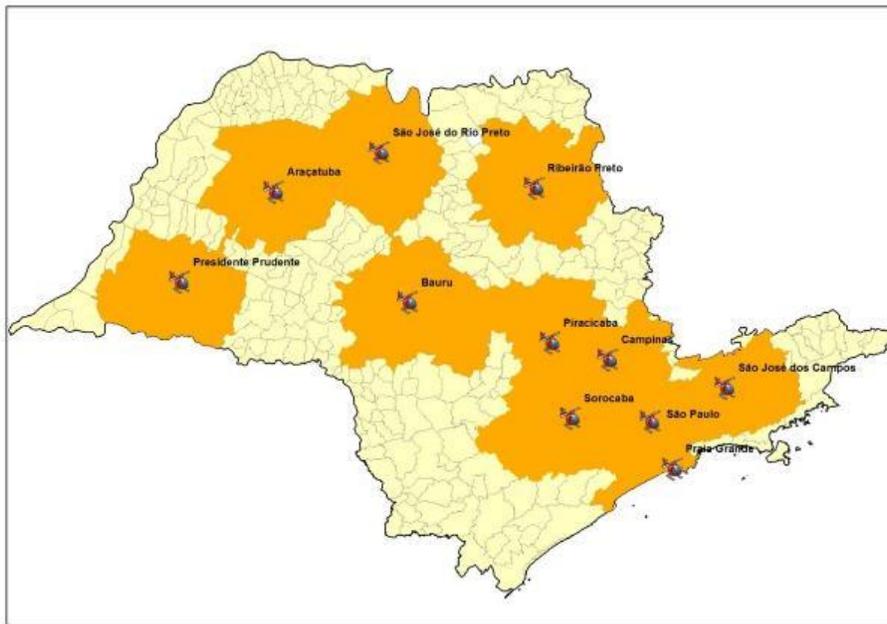
Emergency services and health care are provided to a generally sound level, through SAMU (Ambulance), fire services, and police. On State concession operated roads the concession operator must supply emergency response, and the team witnessed this occurring at one serious rural crash (as shown earlier in Figure) as well as others.

In some states there are helicopter rescue nodes. Figure 25 shows the areas covered by these services in Sao Paulo as an advanced example. These are appropriately concentrated in large population clusters. The areas depicted represent approximately the reach of the services in a 20 minute flying range. Other positive features of emergency response include that ambulances often have doctors, doctors may use motorcycles to reach crash scenes more quickly in heavy traffic, hospitals are selected for transport of patients based on daily updated information on bed and service availability, and GRAU (the Emergency Care Rescue Group) supply doctors to fire brigades.

There are other key concerns:

- In all states, the multiple phone numbers for the public to request help add to delays. This should be addressed.
- Some municipal councils have no access to SAMU, adding to delays in emergency response.
- Improved collaboration between SAMU and the Health Department could improve locations of ambulances for effective coverage.

**Figure 25. Map of coverage of aerial rescue services in São Paulo state showing quite incomplete coverage (Source of information for map: São Paulo Health Secretary).**



## ENCOURAGING AND FACILITATING REDUCED ROAD USE

*The value of non-road transport as a means of reducing road use and thus crashes, deaths and injuries.*

Improved understanding of the Road Safety value of supplying and encouraging use of non-road transport, is of value. Public transport (metro, rail, shipping, air) are all typically safer than road use. Thus, policies and infrastructure which cause a modal shift from road to other transport modes provide Road Safety value and overall safety improvements. Improved Road Safety can reasonably be identified and cost savings estimated as part of the overall assessment of investment in non-road based transport.

### *The Situation in Brazil*

Further expansions of water, rail transport will assist Road Safety. These expansions reduce road based traffic exposure.

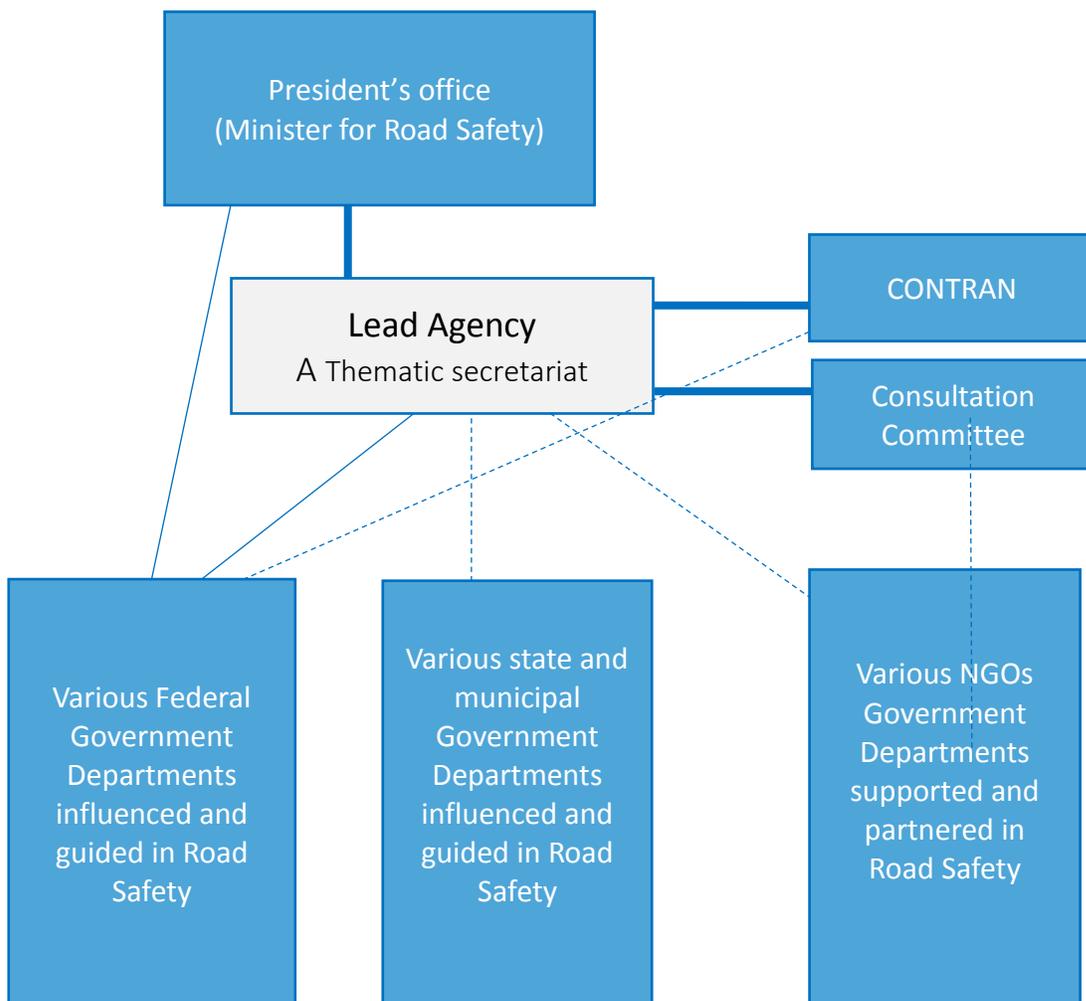
Brazil has a huge coastline, many ports and navigable rivers. Brazil has 8500 km of navigable coast. The Brazilian port complex handled 931 million tons of bulk cargo in 2013, an increase of 2.9% compared to 2012. According to Antaq (National Agency for Water Transports), Brazil transported via inland waterways routes, 38 million tons in the first half of 2014. According to the survey for economically navigable (and viable) routes, conducted by ANTAQ (2014), the main waterways in the country are: Amazon (17,651 km), Tocantins-Araguaia (1360 km), Parana-Tiete (1359 km), Paraguay (591 km), San Francisco (576 kilometers), south (500 km). Further expansion is feasible and is occurring.

Increased use of metro transport is also of value provided that the pedestrian movements created are well managed for safety. Salvador's metro system has also been doubled (to 12km) and Sao Paulo's expanded in recent years.

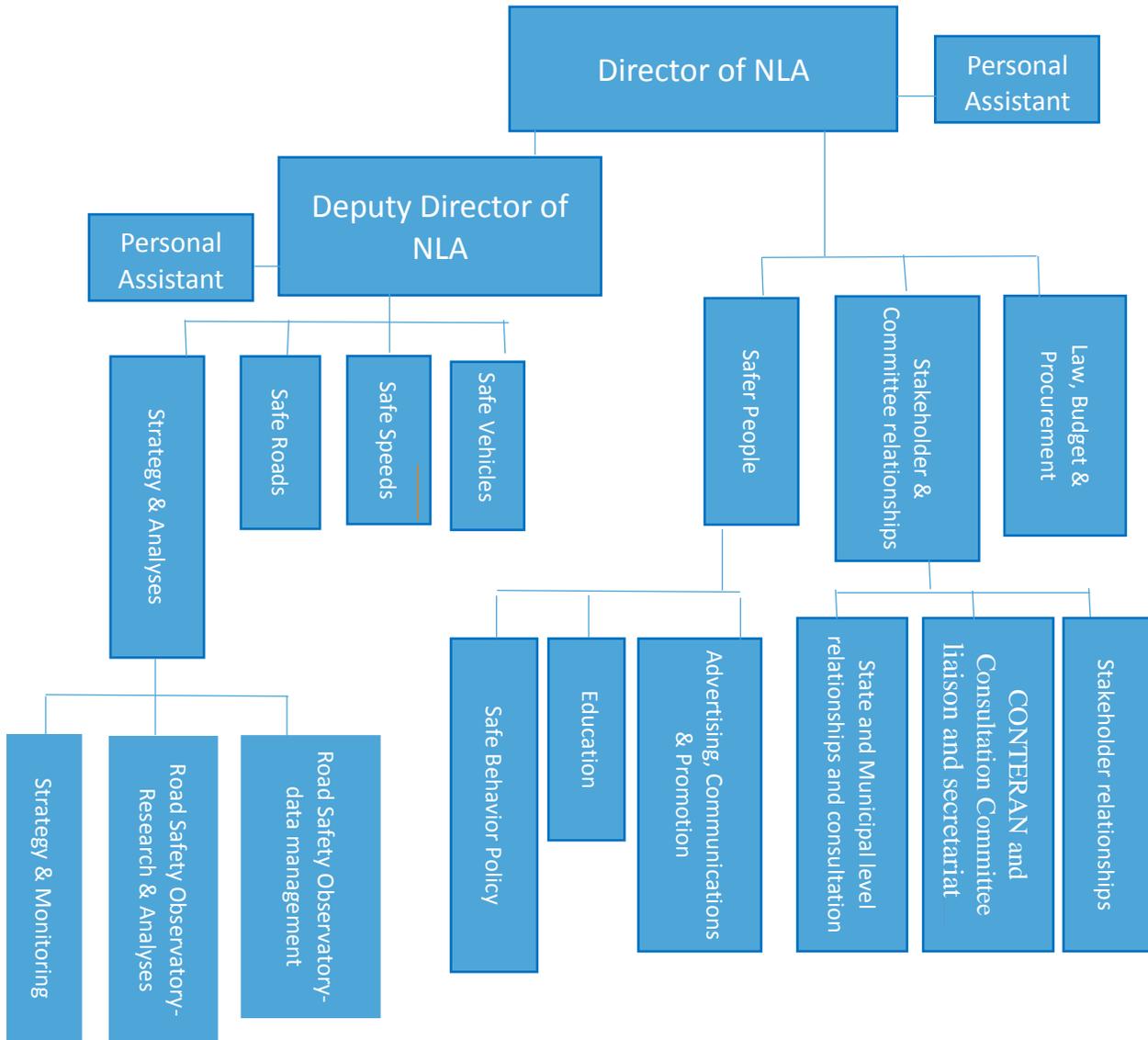
## ANNEX 6 – PROPOSED STRUCTURE FOR THE NATIONAL LEAD AGENCY

Figures below show the suggested structures around the Lead Agency and within the Agency, based on the functions required as identified elsewhere in this report.

**Proposed organizational chart of relationships for the Road Safety Lead Agency (with broken lines indicating influence rather than direct control)**



**Suggested organizational chart of the Road Safety Lead Agency for Brazil**



Features of the Suggested Sstructure

The following features are identified as important advantages of the proposed structure, based on required functions, sound management processes, and organizational psychology:

- The Director should have a deputy director to allow for a sufficiently senior position to act for the director in his or her absence. The deputy director role also allows for the Director to have less direct reporting staff, which will be important for the director to manage the large number of external facing relationships which will need to be managed at a high level. Finally, the deputy director role allows for more effective career progression and succession planning in the organization.

- The structure is aligned with Safe System Principles by including sections for each pillar of safe systems (roads and roadsides, speed, people, and vehicles) explicitly in the proposed structure
- The breadth of required interactions across the different levels of government and the required committees are addressed
- The need for strategy development and performance monitoring are accommodated
- The critical need for the development of sound data systems is also addressed
- A significant (and possibly growing) number of people will be required to manage the budget of the Lead Agency, depending on how much funding is dedicated to Road Safety and managed via the Lead Agency.

### Staff Numbers

Staff numbers for the Lead Agency are inevitably challenging to determine. The right numbers balance the need to retain as much of the Road Safety budget as possible for direct delivery of Road Safety policy and actions yet allows sufficient staff to ensure that the best policies and delivery mechanisms are chosen, to ensure that delivery occurs, to monitor outputs and outcomes, refine actions and report activity to government and the public. The complexity and multiple strand nature of Road Safety mean that this is a significant number of staff. For example, the lead agencies for Road Safety in Slovenia, Sweden, France, and in the state of New South Wales (Australia) all contain over 100 staff.

The following staff numbers are a suggested minimum, which should be revised after a period of operation to ensure that functions are effectively covered and to ensure that areas are not over-staffed the event that the role of the Lead Agency in specific areas is not as envisaged here.

**Suggested approximate staff numbers for the lead Agency as an initial complement to be reviewed once functioning**

<u>Section</u>	<u>Staff numbers</u>
<b>Director, Deputy Director, Assistants</b>	4
<b>Strategy and Analysis</b>	14
<b>Safe Roads</b>	8
<b>Safe Speeds</b>	7
<b>Safe Vehicles</b>	4
<b>Safe People</b>	13
<b>Stakeholder and Committee Relationships</b>	8
<b>Law, Budget and Procurement</b>	10
<b>TOTAL</b>	67

## ANNEX 7 – DETAILED ANALYSIS AND PROPOSALS ON LEGAL AND REGULATORY FRAMEWORK FOR ROAD SAFETY

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The present appendix is based on an analysis of the data, the legislation, and the legal and administrative procedures, together with key interviews.

There is a seemingly sound body of legislation that stands in contrast to its quite imperfect enforcement. The extensive body of legislation enshrined in the Brazilian Traffic Code [*Código de Tránsito Brasileiro* CTB] and its amendments contain what could be considered the essential elements for the regulation of traffic (with the exception that core tests creating success elsewhere, such as random breath alcohol or drug testing can be refused by the driver): prohibition to exceed the established speed limits, ban on drunk driving, requirement to use restraint systems, etc. In this sense it can be said that the basic legal elements have been covered.

The lack of correspondence between the legal obligations and the human reality stems in large part from the juridical labyrinth resulting from the distribution of authority and the sanctioning system described in the law. The lists of infractions and penalties, and the process by which the former are translated into the latter, amount to complex theoretical prototypes which in practice make it very difficult for the infractions to actually incur penalties, much less in an expeditious manner. It's a basic principle that in order for drivers to obey a law, they have to understand it. Those who do not obey have to pay, and promptly.

The second observation has to do with the legal philosophy in which driving is seen by the driver as a right, not as a privilege granted by the State. Derived from Roman law and the Latin cultural heritage that lives on in countries of Southern Europe and Latin America, the traffic legislation implies that the driver has a nearly inalienable right to drive and that he or she is protected by extraordinary guarantees (sometimes bordering on the absurd) from being deprived of it. The revision described below to the Brazilian Traffic Code should seek to move beyond this concept and introduce the principle that the driver's license is a privilege—a contract or a presumption of trust on the part of the State that allows you to perform the act of driving. In addition, if you do not exercise this privilege correctly, you will be subject to the conditions of the contract, or in other words you will have betrayed the trust that was placed in you, and as a consequence you must lose that privilege immediately in order not to endanger the rest of the users of the roadway.

A third observation that should be noted here is that we are looking at a legal norm that involves highly complex, overlapping processes that are difficult for drivers to understand. One of the essential principles of traffic legislation is that it should be clear and simple to the driver. The attitude of impunity that now prevails on the roadway will begin to disappear when the driver clearly understands that his or her behavior has a concrete consequence and that it occurs immediately. There is no reason that this need to simplify the rules and regulations should prevent the Government from guaranteeing citizens all their legal rights. It can still exercise its

power to impose penalties. This report proposes formulas and solutions that will make processes more agile and at the same time guarantee the rights of citizens.

Finally, it is essential to concentrate normative efforts on controlling those driver actions that actually account for 80% of the problems that lead to traffic crashes. It is logical and reasonable that lawmakers and the administrations responsible for executing oversight will want to control all the behaviors that violate the provisions established in the CTB. However, given the reality, it is worth the effort to establish legal approaches, specific procedures, and special campaigns that focus on three mass behaviors that are the cause of most traffic crashes: alcohol and drugs, speeding, and failure to use restraint systems (for example, seatbelt ).

## **1. Institutional Structure**

The institutional framework of the National Traffic System is established in Chapter II, Articles 5-25, of the Brazilian Traffic Code. The areas of responsibility are defined very strictly, yet they are spread out across various consultative and executive bodies at the federal, state, and municipal levels. Two matters should be examined and given consideration:

### **a) Creation of a National Road Safety Observatory.**

Implementation of an effective national Road Safety policy should include creating a unit responsible for reviewing the incoming data to discover warning signs of problems in areas of concern to the various authorities and police forces responsible for traffic. This unit should actually play a triple role:

- Leading the collection and analysis of data on crashes. This Observatory should be in charge of a National Traffic Accident Registry that would bring together all the reported information on traffic crashes. Having complete, comprehensive, and detailed information on crashes is indispensable in order to analyze the situation and then focus on the leading issues that require decision-making.
- Coordinating the work of a National Council on Road Safety, which would represent all of civil society. There is no simple solution to the problem of traffic crashes. It is therefore necessary to create a unit which, upon receiving objective information on a given situation, would be able to mobilize the forces of civil society as a whole to look for solutions to the problem.
- Developing a multi-year Strategic National Plan on Road Safety policy in Brazil. Once the data have been analyzed and civil society has been heard from, the next step is to draft a National Road Safety Policy for the coming years. This strategy should be the basis for each and every decision taken by the various units responsible for different aspects of traffic management.

### **b) Centralized Service for the Management of Infractions Detected by Fixed Radar Devices.**

Apart from a few central functions (especially standardization, coordination, and record-keeping), responsibilities are delegated to authorities and police forces based on the criterion of ownership of the roadway. Thus, as a general rule, depending on whether a roadway is under federal, state, or local jurisdiction, all responsibilities are delegated to that level: traffic signaling, traffic control, citations, etc. That said, Article 25 allows for the establishment of agreements to transfer authority between the levels in order to make operations more efficient.

This arrangement, which seems logical in terms of the juridical delimitation of responsibilities, becomes counterproductive when it comes to making the traffic control policy understandable to the driver. It should be kept in mind that the driver observes and perceives the traffic context from a single perspective. The current delegation of responsibilities based on which level of government owns the roadway makes it impossible to have a unified strategy for traffic oversight and discipline. Drivers use all the roadways regardless of who is responsible for them, which means that they should have a unified perspective of the policy that governs traffic oversight and discipline. It can happen, for example, that some roads are over-patrolled with cameras, videos, alcohol sobriety checkpoints, etc., whereas other roads that the driver connects with seamlessly have only minimal control. This situation gives drivers a sense of impunity regarding the roadway and the territory they happen to be passing through.

In the case of speed control, at least, for the reasons just given, it is suggested to create a centralized service for the management of violations detected by fixed radar devices. This service, under State civil authority, would handle and process all speed violations captured by fixed radar devices regardless of who owns the roadway where the fixed radar is located. Violations captured by mobile radar devices would continue to fall under the jurisdiction of the respective roadway authorities, although eventually, for ideal functioning, those citations should also be processed centrally. The goal is very clear: it is to convey a sense of “State presence” to the driver in the exercise of traffic oversight and discipline.

Almost all countries with low crash rates have created a centralized system for managing traffic violations. For example, France, the Netherlands, Spain, and the United Kingdom have a service of this kind. In several cases it was necessary to amend the countries’ laws or regulations, and sometimes arrangements were made to redistribute the income collected so that the regional or local authorities would not be deprived of the budgetary income they had previously counted on for Road Safety. In all cases, more money was collected because of improved efficiency, adding to the budgets of those countries that delegated or transferred responsibility to a central authority.

This central authority would be recognized in Chapter II of the CTB, specifying either direct transfer of authority or delegation of responsibility. It is suggested that this provision be included in Article 19, on the functions of the highest executive organ of the Union.

## **2. Traffic Regulations.**

The rules of the road are covered in Chapters III through VII (Articles 26-90) of the CTB. These regulations specify rather precise rules that users of the road (drivers, pedestrians, and cyclists) must follow when using their automobiles, dealing with such points as position in the road, use of lights, intersections, parking, etc. Following the philosophy of Roman traffic law, these articles set out descriptions of the different courses of behavior. Repression and penalties are covered in the following chapters.

The initial impression is that these regulations are basically correct. However, going deeper into the various issues that affect traffic safety in one way or another, we feel it is important to call special attention to the rules on speed, alcohol use, and restraint systems.

### **c) Speed.**

The driver must not exceed the speed limits established in the CTB. These speed limits are established taking into account the nature of the roadway (city street, conventional highway, or freeway). Two observations in particular come to mind:

- The section on urban roadways refers to so-called “rapid transit routes.” It would be well to change this designation as long as there is ongoing interaction with pedestrians on these roads. The current designation could contribute to the notion that the motor vehicle takes total and absolute precedence in the urban environment for those not familiar with the roadways, such as new drivers getting their first license. As long as pedestrians are present, some other designation should be adopted.
- In some cases, the speed limits are exceptionally high. In particular:
  - On urban streets with pedestrian crossings, the limit varies from 30km/h to 60 km/h, and sometimes 70 km/h. It is suggested that this limit be revised. Countries with good Road Safety records have limits of 30 km/h to 50 km/h, and in some cases 20 km/h. It should be remembered that the death toll for pedestrians who have been struck follows a relatively simple rule: at 30 km/h, 5 percent of them die; at 50 km/h, 50 percent die; and at 80 km/h and above, mortality can be as high as 90 percent.
  - On conventional highways that are not divided by a median, the limit is 110 km/h, which is also exceptionally high. Most countries with good results have a maximum of 90 km/h. Dividing a highway with a median is one of the best Road Safety measures. When there is no median, vehicles easily move back and forth between the lanes. The speed limit cannot be the same for both types of roadway.

#### **d) Alcohol.**

To start with, it should be pointed out that nowhere do the traffic rules expressly prohibit driving under the influence of alcohol. The penalty is established later in Chapter XV, which deals with penalties, but the prohibition of drunk driving is not included in the rules of the road that the driver has to learn and remember. It is recommended that express wording on this subject be incorporated.

The regulations are also lacking a rule that expressly requires the driver to submit to an alcohol sobriety test. There should be specific language to this effect. If this is not possible for constitutional reasons (the right not to incriminate oneself), the legal obligation to submit oneself to alcohol testing on the roadways by authorized personnel should be included among the conditions for obtaining a driver's license as one of the terms of the contract.

International experience shows that efforts to reduce drink-driving should focus on enforcement for compliance with the alcohol limit established in the CTB.

#### **e) Restraint Systems.**

According to the Brazilian Traffic Code and resolutions passed by the National Traffic Council [*Conselho Nacional de Trânsito* CONTRAN], the installation and use of seat belts is mandatory for vehicles with four or more wheels, as are helmets for motorcycles and mopeds. The CONTRAN resolutions also state that it is mandatory to use child restraint systems.

The legislation is correct and complete insofar as restraint systems are concerned. The only exception allowed by CONTRAN, probably for security reasons, is the use of seat belts in military vehicles.

Nevertheless, with a view to significantly increasing the use of seat belts (which are low in Brazil in front seats and even lower in rear seats), it is essential to insist that the technical standards for vehicle manufacture require acoustic seat belt warning in new vehicles placed in circulation. It is a very low-cost measure, yet it can increase the use of seat belts by 20 to 25%.

### **3. Vehicle Regulations.**

The term *vehicle regulations*, as it is used here, refers to the technical and administrative requirements and standards that must be met in order to place a vehicle in circulation in Brazil. The Brazilian Traffic Code contains many of these requirements in Chapters IX through XIV, Articles 96-139, including the technical requirements to be met before a vehicle can be operated in traffic, stipulations regarding the General Vehicle Registry, administrative procedures related to the vehicle (for example, transfer of title), and special provisions governing school buses and

motorcycles used for transportation. CONTRAN supplements the legislation enshrined in the CTB with many additional regulations on a wide range of subjects.

A reading of the CTB articles cited above leads to the following observations:

- In general, the technical standards required of the vehicles are consistent with the country's conditions of economic development. Insofar as possible, steps should be taken toward making certain safety elements mandatory—for example, anti-lock breaking systems (ABS) on motorcycles, electronic stability control (ESC) on four-wheel vehicles, etc. It is also suggested to require safety equipment that the driver can deploy in the event of an crash or other emergency that has caused the vehicle to be stopped on the roadway - in other words, accessories that the driver of the stopped vehicle can use to warn other drivers of an upcoming hazard (portable triangles, emergency lights, a reflective vest for the driver, etc.).
- On the subject of mopeds (two-wheel vehicles with an engine of 50 cc or less), various international bodies specialized in roadway safety have pointed out that in the coming years the main concern in vehicle-related mortality will be focused on mopeds and motorcycles and this is already the case in Brazil. Thus, in order to be able to fully diagnose the problem and adopt traffic enforcement and disciplinary measures that will make it possible to exercise effective control over mopeds, it is suggested that they be included in the in the National Motor Vehicles Registry [Registro Nacional de Veículos Automóveis RENAVAL].
- The CTB, in its Articles 130 and 131, provides an important tool for regulating the use of vehicles under the heading of registration [Licenciamento]. Basically, it establishes a system in which all vehicles must undergo an annual inspection in order to be licensed to operate. Furthermore, no vehicle may be registered unless all pending fees and penalties have been paid.

While the measure in itself is appropriate, a few observations are in order:

- Control over vehicles that are not presented for annual registration renewal should be improved. Automatic number plate recognition systems that read license plates may be expanded for this purpose.
- The annual renewal could also be an opportunity to require all vehicles to install a safe driver telematic unit that automatically alerts the driver to traffic violations. Currently this system is regulated under Resolution 488 of May 7, 2014, which also recognizes the Official Electronic Mailbox [Caixa Eletrónica Oficial, or e-CPO] as an e-mail system that can be used instead of postal mail. The gradual implementation of electronic notifications prior to authorization of the use of vehicles is recommended.

#### **4. Driving Regulations.**

The regulations on obtaining driver's licenses are contained in the CTB, Chapter XV, Articles 140-160, under the heading Licensing [*Habilitação*]. They describe the conditions for obtaining permission to drive, the different classes of driver's licenses, recording of the circumstances under which the license was granted in the Registry of Drivers [*Registro Nacional de Carteira de Habilitação* RENACH], and the requirements that must be met by those who intend to teach driving. The regulations are quite complete, but call for the following observations.

##### **a) Permission to Operate Mopeds.**

The general regulations on driver's licenses are silent on the subject of mopeds. Permission to operate these vehicles is covered elsewhere in the CTB, where a "municipal license" is established for the purpose. It is suggested that this permission be included the general regulations on ordinary driver's licenses and that tests and mechanisms be established in the CTB itself so that the applicant is required to meet certain conditions in order to receive a license. Since international organizations have singled out crashes from the use of motorcycles and mopeds as a subject of special concern, the regularization of licensing for this type of vehicle is especially important.

##### **b) Restructuring of Class A Licenses.**

It is required to obtain a Class A license in order to operate a two-wheel motor vehicle, regardless of the number of cylinders, weight, or power/weight ratio. In other words, any type of motorcycle can be driven under a single license class.

Reality indicates, however, that with the increased adoption of safety measures for four-wheel vehicles, trucks, and buses, attention should now be focused on the high rates of death and injury on roads and highways from the use of two-wheel vehicles. It is clear that the requirements for obtaining a license to operate a motorcycle should be tightened in order to ensure the highest level of ability and a responsible attitude on the part of the operator. Therefore, it is suggested to draft a new text for the Class A license that will include the following two characteristics:

- Introduction of more tests and requirements for the motorcycle category.
- Introduction of a full graduated licensing system for motorcycle (and car drivers) with restrictions on the power of the motorcycle ridden for the novice rider licensing class.

##### **c) Restructuring of Class C and D Licenses.**

The Class C and D licenses authorize the operation of vehicles for the transportation merchandise weighing over 3,500 kg and the transportation of travelers, respectively. The reality is that both

these categories involve vehicles whose size and dimensions are unrelated to the demands placed on the driver.

It is therefore suggested to establish subcategories within this type of license:

- In the case of Class C, based on maximum authorized weight (e.g., up to 6,500 kg and over 6,500 kg).
- In the case of Class D, based on number of seats.

#### **d) Electronic Notification System.**

Resolution 488 of May 7, 2014, mentioned earlier, recognizes the Official Electronic Mailbox (e-CPO) as an alternative to postal mail for the driver to receive electronic notifications of traffic offenses.

Notification is an especially important factor in the organization and oversight of traffic discipline. It is therefore suggested that the requirements for obtaining or renewing the driver's license should specify that the driver must have signed up to receive electronic notifications. In this way, any infractions, notifications, or communications regarding what the driver is required to do will take place through platform and not on paper.

### **5. Fines and Penalties.**

The most important factor for a country to achieve steady progress in the area of Road Safety, and therefore in the reduction of crashes and their consequences, is undoubtedly the establishment of a system for levying fines and penalties that is effective, agile, and easy for the citizen to comply with. Such a system will begin to dispel the attitude of impunity as drivers start to gain respect for the established order and reduce the number of infractions committed.

The system of traffic fines and penalties is regulated under the CTB in Chapters XV through XIX, Articles 161-312, under the following headings:

- Infractions –description of the punishable acts;
- Penalties and Administrative Measures – consequences derived from committing the infractions;
- Administrative Procedure – steps in the procedure from citing the infraction to imposing the penalty.

### a) Infractions.

Articles 161-255 describe the various acts that violate the traffic regulations established in the CTB. The regulations, which are very extensive, cover the entire range of acts that can go against traffic safety.

**Drunk driving** is covered in Article 165, but without establishing a concrete limit (usually stated as “under the influence”), and the penalty is suspension of the driver’s license for 12 months. The description of the circumstances, even though the language has since been refined in CONTRAN resolutions, gives the impression that the lawmakers’ intention was to punish alcohol consumption itself with zero tolerance of its mere presence. The amount of effective on road enforcement is more important than the move to zero levels, and the level must be such that Police do enforce it. An analysis of the legal and managerial aspects of alcohol enforcement would indicate that there are issues with both. Two recommendations can be made in this regard:

- Set a national goal for alcohol sobriety testing. A minimum target would be to test one in three drivers every year.
- It is recommended that punishment be graded to the level of offence, with fines and administrative penalties when the blood alcohol level is in the lowest range (from 0 to 0.02), and reserve penal punishment and long term suspension of the driver’s license for more serious cases.

**Driving over the speed limit (Article 218).** There are two observations about the subject of speeding in the CTB:

- The provisions come at the end of a long list of offenses, after parking violations and other infractions that have little or nothing to do with roadway safety policy. While this is just a matter of form, rather than substance, it is suggested that the importance of speeding as a cause of crashes should be reflected in the text of the law by placing it alongside drunk driving, which is at the top of the list.
- Excess speed is defined on a scale, based on percentages of the speed limit in question (20% over the limit, 50% over, etc.). To give the driver a clearer view of the consequences of exceeding the speed limit, it is suggested that a graph be included in the regulations, either in the body of the text or as an annex, that will be more intuitive for the driver, giving him or her a better sense of speed control.

### b) Penalties.

The consequences or punishments resulting from the commission of administrative offenses are regulated in Chapter XVI of the Brazilian Traffic Code, Articles 256-268. The punishments are listed as follows:

- I. Written warning;

- II. Fine;
- III. Suspension of the right to drive;
- IV. Confiscation of the vehicle;
- V. Cancellation of the national driver's license;
- VI. Cancellation of permission to drive;
- VII. Compulsory refresher driving course.

From a reading of the precepts on which these measures are based, the following observations and recommendations come to mind:

- Paragraph 1 of Article 256 states that application of the penalties stipulated under the CTB does not exempt the driver from penalties imposed for criminal offenses arising from traffic offenses. This provision may violate the doctrine of *non bis in idem* ('not tried twice for the same act', similar to the Anglo-Saxon principle of double jeopardy). In other words, it implies double punishment (administrative and penal) for the same act. It is not advisable for the driver to gain the impression that he or she might suffer different consequences for the same act, to be dragged out over time in both the administrative and penal systems. The punishment policy should be clear to the driver: the aim is to produce an automatic association between the action that violates the law and the penalty. Doubling the consequences clearly does not help to attain this objective.
- In addition to suspending permission to drive, there is also the possibility, in some circumstances, of **deducting cumulative points** against the driver's license. This penalty also bears on the point just mentioned. The establishment of double punishment for the same act does not help to create a traffic punishment policy that is clear and simple for the driver. On the contrary, it encourages the driver not to comply with the law, being aware that there are many obstacles involved.
- **Confiscation of the vehicle under certain conditions.** This amounts to punishing the driver by taking control of his or her own personal property. While this measure appears to be logical, in principle, for certain actions, the fact is that the driver-owner relationship is being increasingly undermined in Brazil's current climate and conditions of economic development. The registration of vehicles in the name of corporations under rental arrangements and other legal usage formulas means that confiscation of the vehicle may not meet the intended objective of imposing consequences on the driver. The legislation should consider for this circumstance.
- **Bank account levy.** A measure that has been very effective in administrative traffic law has been the inclusion of provisions in the legislation that allow the Administration to levy a citizen's bank account if a fine is not paid (once all the appeals have been exhausted and the charges have been settled). It is suggested that this possibility be explored, given the powerful effect it can have on dispelling the attitude of impunity. There are various legal formulas for the purpose: through the executive authority delegated to the Administration, declaration of a bank account upon obtaining the driver's license, etc.

- **Compulsory refresher driving course.** Among the measures established for penalizing a driver is a compulsory refresher driving course in the case of certain offenses. The content of this course is regulated in CONTRAN Resolution 168/04. In the description of the content, there seems to be excessive emphasis on knowledge of traffic legislation—rules of the road, signals, licensing and authorization, etc. In the regard, it may be pointed out that, as a general rule, the offender is not unaware of the rules of the road. The real problem is his or her deliberate noncompliance. It is therefore suggested that the normative content of these courses be reduced and more emphasis be placed on knowledge about awareness of the causes of traffic crashes and the need to modify their behavior for the safety of all.

### c) **Administrative Procedures for Imposing Penalties**

Administrative procedures for imposing traffic penalties are regulated in Chapter XVIII del Brazilian Traffic Code, Articles 280-290. A reading of these articles suggests the following observations and recommendations.

First, one key to addressing the behavioral contributions a country's traffic crash problem usually turns out to be the existence of effective administrative penalty procedures. A penalty procedure that is agile, clear, simple, and expeditious for the driver is essential to bringing about a radical change in the behavior of the driving population. The fundamental objective is to dispel the attitude of impunity by creating awareness that those who do not obey have to pay, and promptly.

These observations should be kept in mind at the time of a comprehensive reform of the country's traffic regulation system. This means, a *sensu contrario*, reducing the emphasis on other parts of the regulations that are less important. Writing up more or fewer offenses or setting stiffer or more lenient penalties is secondary. What is needed is a new comprehensive set of regulations on the penalty procedures.

Second, the regulations contained the Brazilian Traffic Code correspond to a traditional model, which is true of most regulations in the Latin American countries. Basically, the model used for the traffic penalty procedure is the same as that used for all other matters of administrative law that a country deals with: notifications, claims, resolutions, appeals, rejoinders, etc. As in other countries, the idea is to use a common legal formula to handle all issues. However, traffic penalties require a different approach. There are two fundamental reasons why traffic penalties are different:

- With traffic penalties, the charges are clear, evident, and proven (99 percent) because the event has been confirmed either by an agent or by a technological device under State control.
- Traffic law is the law that is most violated in any country by a wide margin compared with all other legislation: fiscal, labor, public order, public health, etc.

For both reasons, it is recommended that a specific procedure be established for traffic penalties, unlike the rest of the legislation, which takes both these characteristics into account.

Third, the objective of the reform currently being considered should be very clear. The goal is to collect at least 80% of the fines within less than two months after the citations are issued. As this percentage increases and the time period gets shorter, the attitude of impunity will gradually disappear.

In this regard, it is also recommended that the driver be offered the option of an alternative accelerated procedure (based on terms mutually agreed upon) at the time the citation is issued. When the facts are undisputable (because of the presence of an agent or use of a technological device), the law should make it easy for the driver to pay the fine or comply with the penalty. The current legislation does not allow for this; the driver who wants to pay the penalty is required to go through a series of bureaucratic steps. Once the citation is issued, the driver should have the opportunity to comply and pay the penalty, even immediately “on the spot.”

The concrete elements in achieving this objective may be summarized as follows:

- Establishment of an accelerated procedure, an alternative to the general procedure, in which the driver is offered the option of reaching an immediate agreement with the Administration (payment, suspension, etc.) and closing the case. As a benefit for settling up immediately, the Administration may agree to a discount on the fine, a shorter period without permission to drive, or a reduction in the number of points against his or her license.
- Inclusion, within the terms of the citation, of a schedule for payment of the fine or immediate compliance with suspension of the driver’s license. The rights of citizens are not violated by an offer to close the case. Voluntary termination is undoubtedly a feasible option that does not infringe upon any right whatsoever.
- Compulsory use of the electronic notification system in certain cases (e.g., new vehicles owned by corporations, leased vehicles, etc.).
- Accurate metrological control systems, especially for professional transportation.
- Electronic updates on pending cases.

## **6. Regulations on Traffic Crash Statistics.**

The solution to a country’s Road Safety problems lies in implementing a series of measures and actions in the areas of policy, management, legislation, public relations, etc. However, the many decisions involved can only be made if the statistical information is complete and reliable and specifies the circumstances of the country’s traffic crashes and their causes. Not meeting these criteria could lead to a mistaken diagnosis and adoption of the wrong measures. For this reason, the following measures are suggested.

### **a) Creation of a National Traffic Crash Registry**

In Brazil, the existence of multiple administrations and security forces with responsibilities in this area means that each of the different entities has a traffic crash database for its own territory (usually a highway or road system), and each of these databases has its own parameters, software, data collection processes, criteria, etc.

Thus, Brazil does not have a centralized, legally recognized database to which all the responsible administrations are required to submit their information. It is recommended that it is time to create a National Traffic Crash Registry at the federal level.

### **b) Generation of the Crash Statistics**

The collection of traffic crash information is vital to arriving at a correct diagnosis of the situation. Thus, there should be unique parameters for all the information to be included, with specification of the forms to be filled out and definitions for each field that leave no room for misinterpretation. The fact that federally regulated standards are applied to crash statistics is the guarantee that the data entered in the Registry will be accurate and appropriate for timely decision-making.

### **c) Regulation of Reporting to the National Traffic Crash Registry**

Once the National Traffic Crash Registry and the statistical capability have been established, there will need to be regulations to specify the compulsory nature and required frequency of reports to the Registry. They should indicate the persons or institutions required to provide the information (agents in authority, hospitals, firefighters, etc.) and the schedule on which they should do so (e.g., every 24 hours, every 30 days, for regular monitoring, etc.).

## **7. Target-based Legislation**

Traditionally, countries have made changes in Traffic and Road Safety Legislation based on estimates or a broad vision of the problems, often emerging from public opinion and policy discussions. As a general rule, they are not based on a predefined list of concrete targets that can help to ensure that the new regulations are on track to fulfilling their intent a year or two after they have been on the books.

It is suggested that the Government develop a strategic document for the coming years containing specific, concrete, and well-defined targets to be achieved by means of the forthcoming revision of the law, so that these targets will be kept in mind in the development and interpretation of the regulatory changes to be implemented in the CTB and the CONTRAN resolutions. Lawmakers should be aware that the new legislation will be subjected to a “valuation audit” (to be specified in the law) a year after its implementation. If the legislation is not going to contribute to achieving these concrete pre-established targets, it should be discarded.

These are the targets:

**a) 85% of Fines Paid.**

From an analysis of the data and interviews held with various authorities and traffic police, it is concluded that the percentage of fines paid relative to the number of citations issued is quite low. This situation fosters a culture of noncompliance.

The yardstick for measuring this attitude of impunity is the percentage of fines that have been paid. The attitude of impunity will only disappear when most of the fines are paid. The idea is to replace it with a “culture of compliance.”

This goal takes precedence over any in the other in the changes to the schedule of penalties. And, in order to achieve it, all the related sections—on infractions, punishments, procedures, administrative measures, etc.—should be redrafted with this goal in mind. Reaching this goal is so important that the following modifications are needed in the penalty regulations in order for it to be met: establishment of an alternative accelerated procedure that awards prompt payment, bank account levies, and overall reduction of the weight of the penalties, among others. The purpose of all these changes is to ensure that the driving population in general will comply with the law and feel that they have served their due punishment.

**b) 80% of Fines processed within 45 days.**

The attitude of impunity in a traffic context is exhibited both by failure to pay fines and by long delays in payment. It is important to foster a culture in which those who don't obey have to pay, and promptly.

From a study of the statistics and from interviews, it can be seen that under the current penalty and judicial procedures the average time for payment of a penalty begins at the earliest after two or three months have passed to allow for notification, acknowledgment of receipt, etc. In the legislative reforms soon to be proposed, it will be necessary to include the goal, as a general rule, of immediate payment of the fine.

**c) Average time to initiate Suspension of the Right to Drive no longer than 4 Months.**

In line with what has been said before, the attitude of impunity is also seen in the general view of the driving population that if they commit a violation punishable by suspension of their license, it is not going to happen. And if they are convicted, the punishment may be delayed for two or three years—long after they will feel any sense of punishment for breaking the law.

In these circumstances, and in keeping with earlier comments, it is suggested to adopt regulatory changes that facilitate complying with suspension of the driver's license immediately. In this connect, one of the suggested changes in the law is to reduce the suspension period by a percentage (e.g., from 12 to 6 months) if the offender voluntarily accepts the punishment within a specified period (e.g., 30 days).

For attainment of this objective, lawmakers should not be hesitant to reduce the period of suspension as long as the result has a greater effect in the end. International experience has shown that long periods of license suspension lead to an opposite effect, since the offender keeps on driving without a license. By contrast, shorter periods (even the possibility of allowing the driver to split up the days), lead to more effective results.

**d) Less than 3% of Total Citations Appealed.**

Management of the traffic penalty procedure starts in most cases with a citation by a traffic agent or proof obtained through system under the metrological control of the government—certainly cases in which there is no doubt with regard to occurrence of the event. The filing of appeals or claims in this type of procedure tends to be devoid of substance—a mere formality, not respecting the intent for which the procedure was designed.

As a general rule, since the facts attributed to the citation or in the notification are absolutely clear and precise, the legal procedure that has been generated should be followed in most cases by payment of the penalty, thus reducing the percentage of cases that are appealed or contested to a minimum.

It is therefore recommended to introduce changes in the legislation on the penalty procedure which, while guaranteeing the citizen's right to defend him- or herself, encourage the driver to pay the fine immediately and close the case. Thus, it is suggested to create an "alternative accelerated procedure" for drivers in which, if they face compliance, the case is immediately closed without any possibility of appealing or contesting it. In other words, it would be a "conventional termination" of the procedure between the Administration and the citizen being offered as a reasonable alternative to the bureaucratic maze that currently exists.

**e) Standardization of the amounts of fines with consideration of the minimum wage, or the setting of penalties adjusted to ability to pay**

There is a widespread belief in the field of penalty legislation (not only with respect to traffic, but especially in this area) that larger numbers in and of themselves mean better results. In the case of roadway safety, it is believed that announcing larger numbers of convictions will instill "fear" in drivers, which will make them change. Their behavior is expected to improve as a result of announcements about the law and its application.

The truth is quite the opposite. The minimal effect of announcing these numbers lasts for a short time. After that, the penalties only have value if they have the following characteristics:

- Unified treatment. Establishment of a standard schedule (e.g., only three levels, for minor, serious, and very serious infractions) gives the driver a precise and certain idea of the punishment that will be imposed for a violation of the law, which leads to a general improvement in compliance.

- Reasonable penalties. The most important factor in establishing a traffic penalty is that the amount of the fine or the impact of other penalties is reasonable for the offender to assume. Once a violation has been committed, the offender should have a realistic possibility of paying the penalty and closing the case. Heavy fines and stiff penalties only produce a double reaction: first, failure to pay on the part of the driver, and second, general disregard for Road Safety policy.

**f) Regulation of Speed using a Tachograph for Trucks and Buses.**

As a general rule, countries with effective Road Safety policies see few speed limit offenses when vehicles that carry merchandise when vehicles are required to have a tachograph device. The reason behind this is that, when a tachograph is installed, drivers regulate themselves carefully so that no offenses are recorded. A background enforcement process is required involving inspection of tachograph records for offences and on-road checks for the fitment of working tachographs.

For this reason, appropriate regulatory changes should be introduced in the traffic regulations or the regulations governing State metrological control to ensure the real possibility that knowledge of a violation by the professional driver could result in a citation from the traffic authority, including appropriate enforcement powers.

**g) Alcohol testing of at least 1 in 3 Drivers.**

Driving with a blood alcohol level above the legal limit (drink driving) is undoubtedly one of the main factors contributing to deaths and injuries in any country. In order to reduce drunk driving, it is essential, in addition to imposing the penalty for alcohol use, to create a sense of ongoing control over the driving population. This can be achieved by testing at least 1 in every 3 drivers for alcohol every year, making the driver and his or her family and friends aware of the ongoing presence of alcohol control.

**h) 95% follow-up of Serious Injuries within 30 days.**

Having concrete and detailed information on the circumstances, status, and characteristics of traffic crashes and their consequences is essential for traffic-related decision-making. For this reason, changes are needed in a country's traffic regulations and in the legislation that governs statistics in general to ensure that the large percentage of traffic crash deaths that occur within the 30 days following the event are monitored.

**i) 95% Seat Belt use.**

More and more safety elements are being introduced in vehicles: airbags, Electronic Stability Control (ESC), lane-keeping assist, etc. However, one strategy continues to be the cornerstone of protection for drivers and passengers, though it sometimes gets overlooked—namely, the use of seat belts. Measures to enforce their use may involve taking action (increasing the number of

seat belt checkpoints) or they may be normative (compulsory acoustic warning in new vehicles), but whatever form they take, it is important to adopt them in order to achieve this target.