12. SAFETY

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12. SAFETY

Hospitalisation and death due to injuries and violence are major threats to health across the world. It is estimated that more than five million people die each year as a result of some form of injury and many more are disabled for life[1].

Transportation-related death and injuries constitute a significant proportion of this. For young adults and working age males, road traffic accidents have become a leading cause of death in most countries including India. Given current trends, the global burden of injuries and violence is expected to rise considerably in the coming decades, particularly in low- and middle-income countries like India.

Table 12.1 shows the number of fatalities associated with various modes of transport in India for the years 1971-2011. Statistics for non-fatal injuries are not included as the numbers reported are unreliable. Except for air crash statistics, it is possible that all other numbers are underestimates, as no systematic methods of recording injury and fatality statistics have been established in the country. The statistics as reported by the National Crimes Record Bureau (NCRB) are based on cases reported to the police in the locality where the accident occurred and then collated and sent to the central authorities. Some detailed studies for road traffic crashes estimate that the number of serious injuries reported may be only 20-30 per cent of the actual number[2].

The statistics as reported show that the maximum numbers of fatalities per year occur in road transport, followed by those on railway property. The NCRB classifies railway accidents under two subheadings—'Railroad' and 'Railway other'. The former includes accidents that railway authorities consider to be 'consequential' and the latter includes accidental deaths occurring on railway property. 'Consequential' accidents include collisions, fire cases, level crossing accidents and derailments. In 2011, there were 2,366 'railroad' deaths and 25,872 'railway other' deaths. This latter group would include those killed crossing railway tracks, falling off trains, and other reasons not classified as consequential.

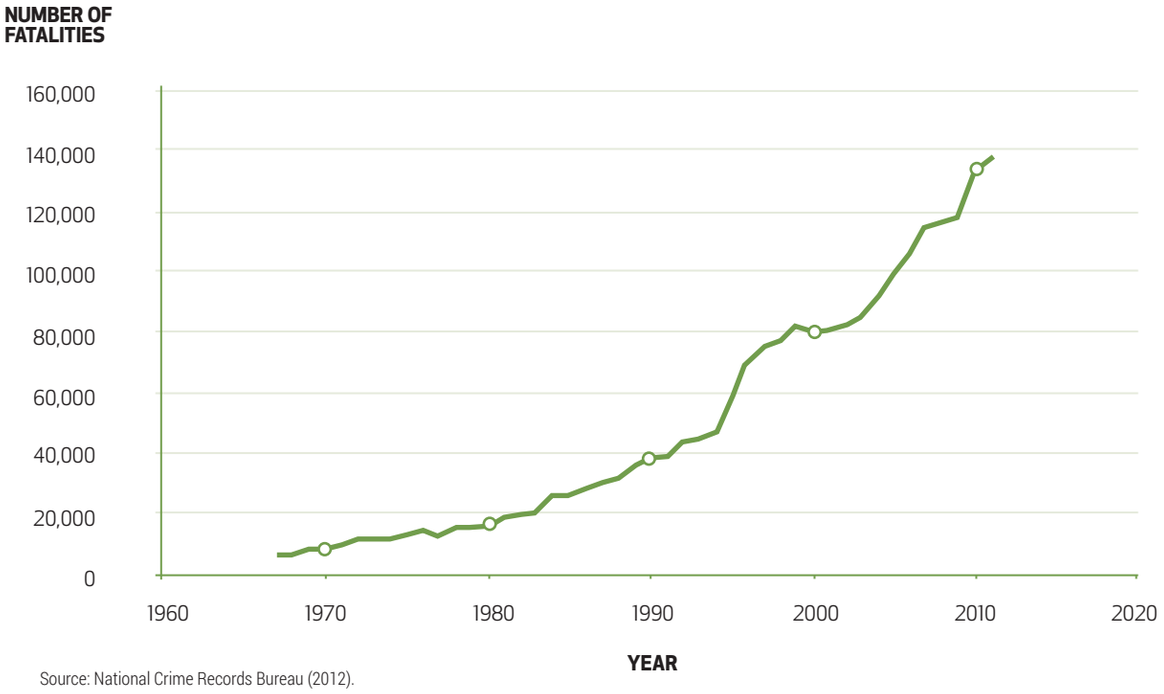
Table 12.1
Incidence of Accidental Deaths by Different Modes of Transport: 1971-2011

	1971	1981	1991	2001	2011
Air crash	205	54	15	30	18
Boat capsize	250	312	422	781	849
Road accident	9,528	17,964	38,973	80,262	136,834
Railroad	1,546	2,614	5,957	2,178	2,366
Railway other	9,652	12,408	16,080	17,076	25,872

Source: National Crime Records Bureau (2012).

1. Schopper, et al.(2006).
2. Gururaj (2005); Mohan, et al. (2009).

Figure 12.1
Road Traffic Fatalities in India, 1967-2011



Source: National Crime Records Bureau (2012).

A few of the inland water transport deaths are captured by the NCRB but not all those associated with coastal shipping. A Planning Commission report states: 'There is also high incidence of accidents in the inland water transport (IWT) sector which caters mainly to passenger traffic. The IWT, however, is in the unorganised sector and there is absence of proper data on such accidents'[3]. It is possible that the number of deaths and injuries associated with water transport and associated infrastructure is much larger than reported by the NCRB.

It is road transport that sees the highest number of fatalities, and the number has been increasing continuously for the past few decades (Figure 12.1). The rate of increase in deaths per year shows a marked upward trend starting in the mid 1990s. Since then, the annual fatality rate has increased at a rate of about 6-8 per cent a year, and shows no sign of decreasing. Two modelling exercises have attempted to predict the time period when we might expect this rate to start to decline in India[4]. Kopits and Cropper used the experience of 88 countries to model the dependence of the total number of fatalities on fatality rates per unit vehicle, vehicles per unit population, and per capita income. They predicted that fatalities in India would continue to increase before starting to decline in 2042. Koornstra, using a cyclically modulated risk decay function model that incorporates the cyclically varying nature of a society's concerns for safety, predicted an earlier date of 2030 for peak traffic fatalities in India. If fatality rates continue to increase at the present level then we can expect about 260,000 fatalities in 2030. Neither of these projected dates (2042 and 2030) can be accepted as road safety goals for the country.

Altogether, more than 166,000 persons died in transportation-related accidents in 2011, or more than 450 a day. International experience suggests that for each transportation death, one can expect about three to five permanent disabilities, 15-20 hospitalisations, and 80-100 minor injuries[5]. This would mean that in addition to the more than 450 deaths a day in 2011, at least 1,500 persons were disabled, 7,000 hospitalised and more than 40,000 sustained minor injuries every day in traffic-related accidents in the country. Table 12.2 shows the disability adjusted life years (DALYs) lost in India due to different causes in 2010[6]. DALY is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. By this measure, road traffic injuries rank 8th among all causes of ill health, ahead of stroke (13), HIV/AIDS (15), diabetes (16), and protein-energy malnutrition. Other causes ranked lower than traffic injuries are (not included in Table 12.2): cirrhosis (22), rheumatic heart disease (35), hypertensive heart disease (40), malaria (43) and lung cancer (46). It is also significant that road traffic injuries have moved up from rank 13 in 1990 to eight in 2010. Among the seven causes that rank higher than road injury, at least four are associated with malnutrition, hygiene and lack of child care facilities (pre-term birth complications,

3. Planning Commission (2002).
4. Koornstra (2007); Kopits and Cropper (2005).
5. Evans (1991); Gururaj (2006); Martinez (1996); NHTSA (2008); Varghese and Mohan (2003).
6. Murray, et al. (2012).

Table 12. 2
Ranking of Health Burden by DALYs Lost Due to Different Causes in India, 2010

RANK	CAUSE	RANK	CAUSE
1	Pre-term birth complications	11	Neonatal encephalopathy
2	Diarrheal diseases	12	Low back pain
3	Lower respiratory infections	13	Stroke
4	Ischemic heart disease	14	Major depressive disorder
5	Chronic obstructive pulmonary disease	15	HIV/AIDS
6	Tuberculosis	16	Diabetes
7	Neonatal sepsis	17	Fire
8	Road injury	18	Congenital anomalies
9	Iron-deficiency anemia	19	Protein-energy malnutrition
10	Self-harm	20	Falls

Source: Murray, et al. (2012).

diarrheal diseases, lower respiratory infections, neonatal sepsis). These estimates clearly indicate that transportation-related injuries and deaths have become a very significant health problem in India.

It is estimated that the cost of road traffic crashes alone may be about 3 per cent of GDP[7] Obviously, the situation is quite serious and unless policies and evidence-based countermeasures are put in place urgently, it is likely to worsen. The air rates are low partly because of the smaller number of people exposed to this mode of travel and especially because safety procedures are governed by international practices.

INTERNATIONAL EXPERIENCE

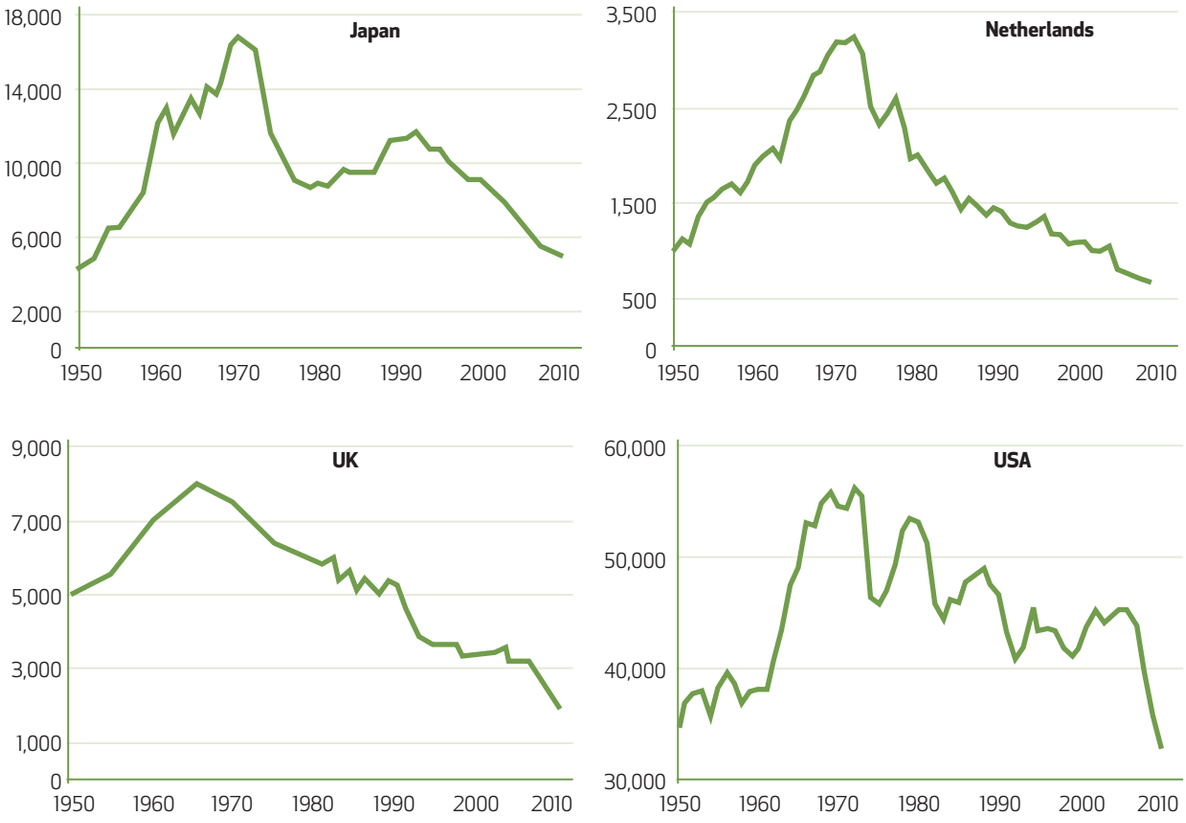
TRENDS IN TRANSPORTATION-RELATED ACCIDENTS

The main reason we have not been able to address the safety issue effectively is that there is little expertise, data, or information available to tackle the problem in a scientific manner. In the international safety professional community, a consensus emerged about half a century ago that it is not very productive to focus on human error alone. Writing many decades ago, Haddon, W., Jr. asserted that the successes of modern public health measures are substantially the result of a shift from an individual to a community-centred emphasis. He insisted that the 'emphasis has been on the responsibility of individuals in the general public to take steps to reduce injuries, not on the responsibility of the small number of key individuals in public and private power structures. This damagingly lopsided balance is now, however, ponderously shifting as more legal responsibility is being placed on policy-level executives to do what they can'[8]. This shift Haddon refers to is reflected in the time trends of fatal road traffic accident statistics for Japan, Netherlands, UK and the US as shown in Figure 12.2.

The number of road traffic fatalities increased continuously from 1950 to 1970 in all these countries and the general decline started in the early 1970s. The trend is similar in most western European countries, Canada, Australia and New Zealand. Other countries were not able to make this shift and the number of deaths in traffic accidents has continued to increase. The fatality rates per 100,000 persons at the peaks for Japan, Netherlands, UK and the US were 16, 24, 15 and 26 respectively. The rate in India in 2011 was 12. There does not seem to be any pattern regarding the fatality rate at which one should expect a downturn. Recent studies also suggest that there may not be any strong relationship between income and fatality rates, and the level of safety depends on policies and safety measures put in place[9]. With appropriate

7. Committee on Road Safety and Traffic Management (2007).
8. Haddon (1980).
9. Mohan and Bangdiwala (2013).

Figure 12. 2
Road Traffic Fatalities in India, 1967-2011



Source: National Crime Records Bureau (2012).

safety measures, it should be possible to reverse the upward trend in India as road safety knowledge and technologies available today are superior to those in 1970.

As Figures 12.3, 12.4 and 12.5 show, air traffic fatalities reduced tenfold between 1945 and 1968, and then another significant reduction between 1970 and 1980. This is attributed to major changes in airplane and communication technologies. Railroad accident data from the US shows a sixfold decrease in accidents per million train miles between 1980 and 2000, and the UK data a fourfold reduction between 1970 and 1995.

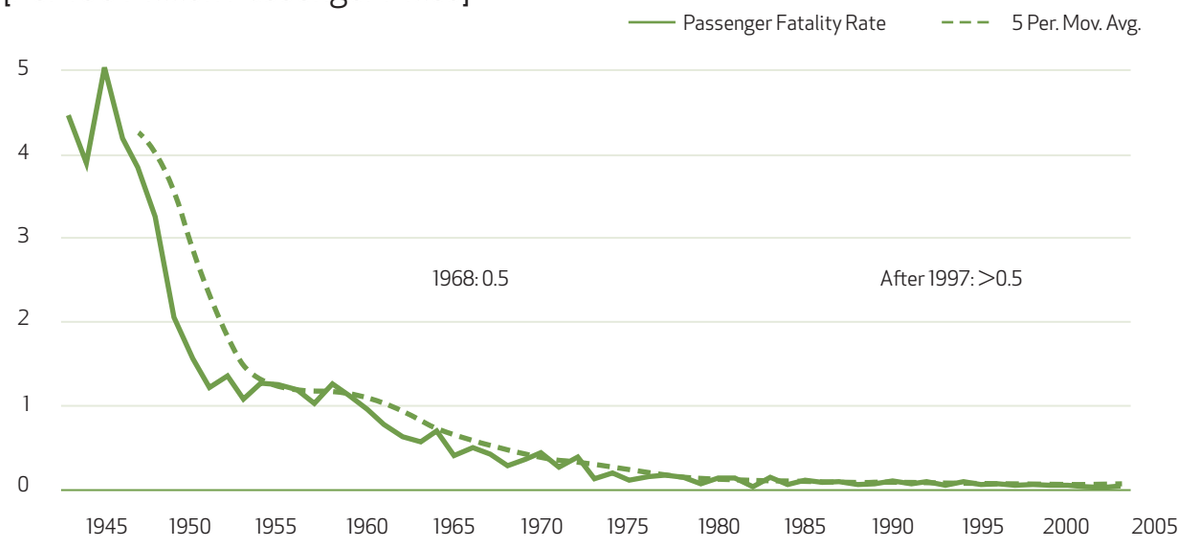
It is interesting that these significant reductions in accident rates seen in all modes of transport in Western Europe and the US start about the same time in the 1960s and 1970s. The reduction in accidents in all these modes is probably not due to any single factor in isolation but to a wide variety of improvements in design of vehicles, operating environment and infrastructure, and enforcement of safety regulations and standards.

Water transportation-related deaths have not been included in this discussion as data on this is notoriously poor within India and internationally[10]. There is no uniform data collection and analysis system and procedures vary from one nation to another. The data is grouped under different heads and types of injuries and are collected by different departments within nations. Data for larger ships may be recorded separately from those for smaller fishing vessels. Many vessels may pick up foreign nationals once underway, and deaths and injuries of these individuals may not be reported in the vessel's country of origin. Injuries and fatalities associated with passengers and crew of vessels other than due to drowning are also reported separately from drowning cases.

However, to get an idea of developments in efforts to prevent drowning, data for deaths due to drowning, including water transport deaths in the US, are shown in Figure 12.6. In 2008, there 3,576 drowning deaths in USA, of which 76 were attributed to water vehicle accidents[11]. The latter number does not include deaths associated with international shipping and other injuries to passengers. However, it is interesting to note that even in the case of drowning deaths in the US, the real reduction in death rates starts in the 1970s.

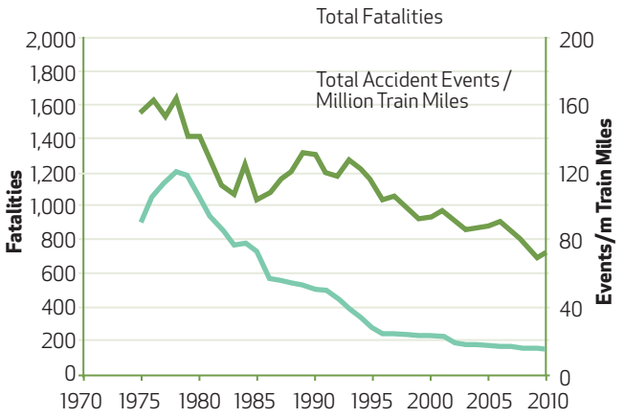
10. Planning Commission (2002); Waller (1985).
11. National Safety Council (2011).

Figure 12. 3
Air Passenger Fatalities
[Per 100 Million Passenger Miles]



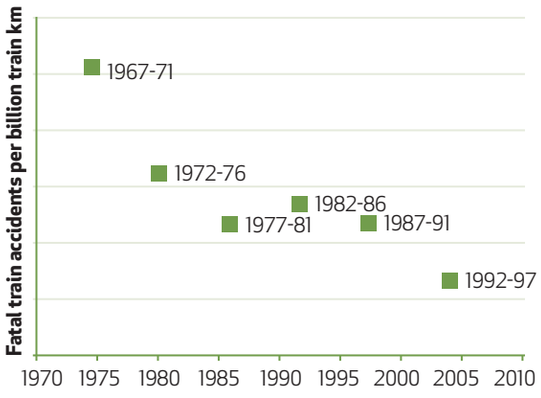
Source: EASA (2005).

Figure 12. 4
Railroad Accidents in the US, 1975-2010



Source: FRA (2012).

Figure 12. 5
Fatal Railroad Accidents per Billion Train Km in the UK, 1967-97



Source: Adapted from Evans (2000).

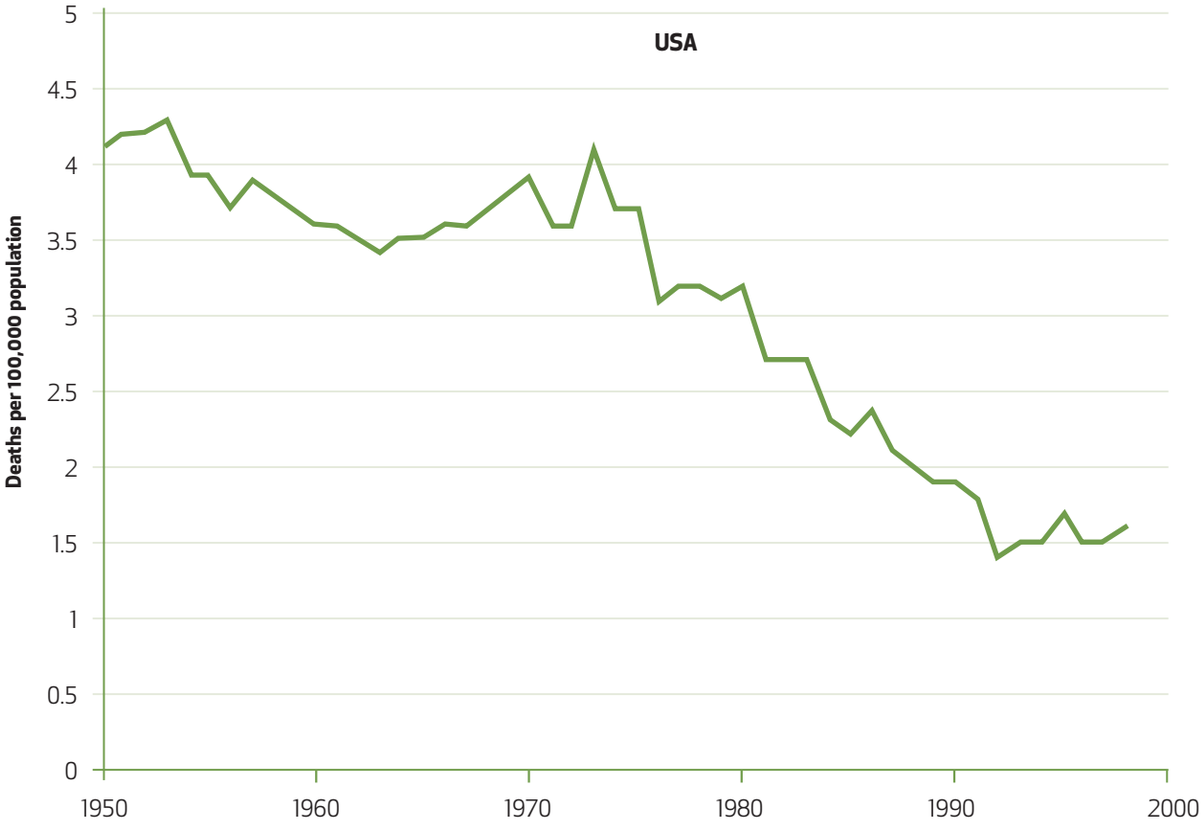
The data indicate that policy makers and transportation safety professionals in every country have found it very difficult to institute changes that actually result in a dramatic decrease in traffic fatalities and injuries in a short time. Experience has also shown that not all individuals follow all the instructions given to them to promote road safety. Attempts to 'educate' people were also not always very effective and wide variations are found between people's knowledge and their actual behaviour[12]. This is partly because we cannot select who is going to use the system and who is not. While some control can be exercised in licensing drivers of motor vehicles, almost no control is possible in selection of pedestrians and bicyclists. Control over the system is most difficult in the case of road transport, much easier in the case of air transport, and railroad and water transport fall somewhere in between. Almost everyone in a population can be a road or railroad user and this has implications on how we deal with the issue of traffic injuries as a public health problem.

The major shift in regarding injuries sustained by people in day-to-day activities as opposed to problems caused by errant individual behaviour took root among safety professionals in the 1960s and 1970s. This helped in analysis of transportation accidents as due to system failures that included mistakes made by individuals. It became important to understand why people make mistakes or behave in

12. Haddon (1968); Mayhew and Simpson (1996); Peden, et al. (2004); Robertson (1983); Robertson, et al. (1974); Sandels (1975).

Figure 12.6

Deaths due to Drowning (Including Water Transport Accidents) in the US, 1950-2010



Source: National Safety Council (2011).

ways harmful to themselves and others. An important part of this understanding was that people's behaviour is itself influenced by vehicle—car, train, plane, boat—design, the infrastructure within which they operate and the level of enforcement of rules and regulations. For example, a significant part of the reduction in road traffic deaths in Western Europe and USA after the 1970s has been attributed to improving crashworthiness of cars, use of protective systems—helmets, seatbelts, airbags, development of safer and forgiving roadways, and enforcement of laws against speeding and driving under the influence of alcohol[13].

The first motorcycle helmet use law in the world was enacted in the state of Victoria, Australia, in January 1961, and the use of seatbelts by vehicle occupants was made compulsory in the state in 1971, followed by the rest of Australia and some other countries in the 1970s and 1980s. Motor vehicle crash-worthiness tests became mandatory in these countries in the 1970s.

Many road and highway design changes were also initiated in the same period:

- Divided highways: 1960s
- Breakaway devices: 1970s
- Energy-absorbing barrier end treatments: late 1970s
- Shoulders widening: 1970s
- Intersection angle limits (> 70°): mid-1960s
- Clear Zone widening: 1970s

This was a major shift away from the policies in the pre-1970s which focussed mainly on changing individual behaviour through 'education' and retribution. Many of these interventions adopted over 30 years ago are still absent in India.

This move from unsuccessful to successful strategies is summarised in Table 12.3.

INTERNATIONAL BEST PRACTICES

Transportation safety management is a systematic process in which we consider the infrastructure, the users and the vehicles as integral components of a complex interactive system. The transport system has to be developed in a way that does not jeopardise the environment or public health and welfare. In this approach, it is essential that an environment be created that minimises the risk of transport users

13. Elvik and Vaa (2004); Johnston (2010); Noland (2003); Trinca, et al. (1988).

Table 12. 3

Historical Experience and Road Safety Paradigms in Vogue During Different Periods in American and European History

ASPECT	RELATIVELY UNSUCCESSFUL		RELATIVELY SUCCESSFUL	
	PARADIGM I	PARADIGM II	PARADIGM III	PARADIGM IV
Period of domination	**1900-1925/35**	**1925/35-1965/70**	**1965/70-1980/85**	**1980/85 →**
Description	Control of motorised carriage	Mastering traffic situations	Managing traffic system	Managing transport system
Main idea and focus	Use cars as horse-drawn carriages	Adapt people to manage traffic situations	Eliminate risk factors from road traffic system	Consider exposure of risks, regulate transport
Motor Vehicles per 1,000 people	Less than 25	25-250	250-500	> 500
Main disciplines involved	Law enforcement	Car and road engineering, psychology	Traffic engineering, traffic medicine, advanced statistics	Advanced technology, systems analysis, sociology communications
Organisation of vehicle production	Craft-production, craftsmen manufacturing	Mass-production workers assembling	Lean production, group assembly on sub-contracting	Recycling materials
Terms used about unwanted events	Collision	Accident	Crash, casualty	Costs, suffering
Idea concerning accidents	Transitional problem, passing stage of maladjustment	Individual problem, inadequate morale and skills	Defective traffic system	Risk exposure
Data ideals in research	Basic statistics, answers on 'what'	Causes of accidents; 'why'	Cost/benefit ratio of means, 'how, why, what, when, where.'	Multidimensional
Organisational form of the safety work	Separate efforts on trial-and-error basis	Co-ordinated efforts on voluntary basis	Programmed efforts, authorised politically	Decentralisation, local institutional management
Typical countermeasures	Vehicle requirements and inspection, school patrols	The three E's doctrine, screening of accident-prone drivers	Combined samples of measures for diminishing risks, focusing on the whole system	Networking and pricing transport costs
Effects	Gradual increase in both traffic and health risks	Increase in deaths and injuries continues	Successive cycles of decrease of health and traffic risks	Continuous reduction of serious road accidents

Source: OECD (1997).

making mistakes and that prevents serious human injury when designing, operating and maintaining the system. The entire traffic and transport system must be designed to account for the limitations and capabilities of users and operators.

In a transport system, the design of vehicles, infrastructure and policing methods have to be aimed primarily at the prevention of traffic crashes irrespective of the characteristics and skills of ordinary users. The system has to be designed such that, in the event of a crash, the consequences are kept to the absolute minimum.

It is far more effective to provide automatic protection than to hope that people will behave in a 'safe' way. Automatic approaches protect individuals without their having to perform some action or behave in a specific manner. For example, a person who chooses not to use her manual seatbelt (or who forgets to buckle it) has no protection in the event of her car crashing. If there is an air cushion system in her car, however, it will inflate to protect her, regardless of her state of mind, level of inebriation, or intelligence.

Since each accident is a result of a combination of human, technology and environmental factors, one cannot understand the risk factors associated with an event unless a sophisticated systems approach is followed. This understanding was behind the Zero Vision of the Road Safety Bill adopted by the Swedish Parliament in October 1997 (Box 12.1)[14]. The vision states that 'the entire transport system must be designed to accommodate the individual who has the worst protection and the lowest

14. Tingvall (1997).

Box 12.1
The Swedish Vision

Vision Zero is a traffic safety policy developed in Sweden in the late 1990s and based on four elements: ethics, responsibility, a philosophy of safety and creating mechanisms for change. The Swedish parliament voted in October 1997 to adopt this policy, and since then several other countries have followed suit.

Ethics Human life and health are paramount. According to *Vision Zero*, life and health should not be allowed in the long run to be traded off against the benefits of the road transport system, such as mobility. Mobility and accessibility are therefore functions of the inherent safety of the system, not vice versa as it is generally viewed today.

Responsibility Until recently, responsibility for crashes and injuries was placed principally on the individual road user. In *Vision Zero*, responsibility is shared between the providers of the system and the road users. The system designers and enforcers—such as those providing the road infrastructure, the car-making industry and the police—are responsible for the functioning of the system. At the same time, the road user is responsible for following basic rules, such as obeying speed limits and not driving while under the influence of alcohol. If road users fail to follow such rules, the responsibility falls on the system designers to redesign the system, including rules and regulations.

Safety philosophy Traditionally. the approach to road safety was generally to put the onus on the road user. In *Vision Zero*, this is replaced by an outlook that has been used with success in other fields. Its two premises are: human beings make errors; and there is a critical limit beyond which survival and recovery from an injury are not possible. It is clear that a system that combines human beings with fast-moving, heavy machines will be very unstable. It is sufficient for a driver of a vehicle to lose control for just a fraction of a second for a human tragedy to occur. The road transport system should therefore be able to take account of human failings and absorb errors in such a way as to avoid deaths and serious injuries. Crashes and even minor injuries, on the other hand, need to be accepted. The important point is that the chain of events that leads to a death or disability must be broken, and in a way that is sustainable, so that over the longer time period, loss of health is eliminated. The limiting factor of this system is the human tolerance to mechanical force. The chain of events leading to a death or serious injury can be broken at any point. However, the inherent safety of the system—and that of the road user—is determined by people not being exposed to forces that go beyond human tolerance. The components of the road transport system, including road infrastructure, vehicles and restraint systems, thus need to be designed in such a way that they are interlinked. The amount of energy in the system must be kept below critical limits by ensuring that speed is restricted.

Driving mechanisms for change To change the system involves following the first three elements of the policy. While society as a whole benefits from a safe road transport system in economic terms, *Vision Zero* relates to the citizen as an individual and his or her right to survive in a complex system. It is therefore the demand from the citizen for survival and health that is the main driving force. In *Vision Zero*, the providers and enforcers of the road transport system are responsible to citizens and must guarantee their safety in the long term. In so doing, they are necessarily required to cooperate with each other, because simply looking after their own individual components will not produce a safe system. At the same time, the road user has an obligation to comply with the basic rules of road safety. In Sweden, the main measures undertaken to date include:

- Safety performance goals for various parts of the road traffic system;
- Focusing on vehicle crash protection, and support for the consumer information programme of the European New Car Assessment Programme (EuroNCAP) and securing higher levels of seat-belt use and fitting smart, audible seatbelt reminders in new cars;
- Installing crash-protective central barriers on single-carriageway rural roads and encouraging local authorities to implement 30 km/h zones;
- Wider use of speed camera technology, and an increase in the number of random breath tests;
- Promotion of safety as a competitive variable in road transport contracts.

While *Vision Zero* does not say that historically, road safety ambitions have been wrong, it is clear that the actions that would have to be taken are partly different. The main differences probably can be

found within how safety is being promoted; and also, some innovations result from the vision, especially in infrastructure and speed management.

A tool for all *Vision Zero* is relevant to any country that aims to create a sustainable road transport system, and not just for the excessively ambitious or wealthy ones. Its basic principles can be applied to any type of road transport system, at any stage of development. Adopting *Vision Zero* means avoiding the usual costly process of trial and error, and using a proven and effective method right from the start.

Source: Peden, et al. (2004).

Box 12.2
Safe Systems Approach in Road Safety

A Safe System approach is also well attuned to the high priority global, regional and country development goals of sustainability, harmonisation and inclusiveness. A Safe System is dedicated to the elimination of deaths and injuries that undermine the sustainability of road transport networks and the communities they serve. Its focus on safer and reduced speeds harmonises with other efforts to reduce local air pollution, greenhouse gases and energy consumption. And its priority to afford protection to all road users is inclusive of the most vulnerable at-risk groups such as pedestrians, young and old, cyclists and motorcyclists. These co-benefits of shifting to a Safe System approach further strengthen the business case for its implementation.

Source: Bliss and Breen (2009).

tolerance of violence. No event must be allowed to generate a level of violence that is so high that it represents an unacceptable loss of health for that vulnerable individual,' and, 'the responsibility for every death or loss of health in the road transport system rests with the person responsible for the design of that system.' This approach has not been internalised by any official organisation or institution dealing with safety in India, and we still operate on the outmoded principles of finding fault with an individual and then acting accordingly.

Transportation safety management has seen a shift from action based on experience, intuition, judgement and tradition, to action based on scientific research, empirical evidence, and from consideration of safety that is tacit and qualitative to consideration of transportation safety that is explicit and quantitative. Therefore, expanding the existing system without changing it is not the best use of scarce resources. Most importantly, structures and processes need to be put in place that outlast individuals and ensure regular review and renewal of strategies. The requirements of a Safe System approach (Box 12.2) are:

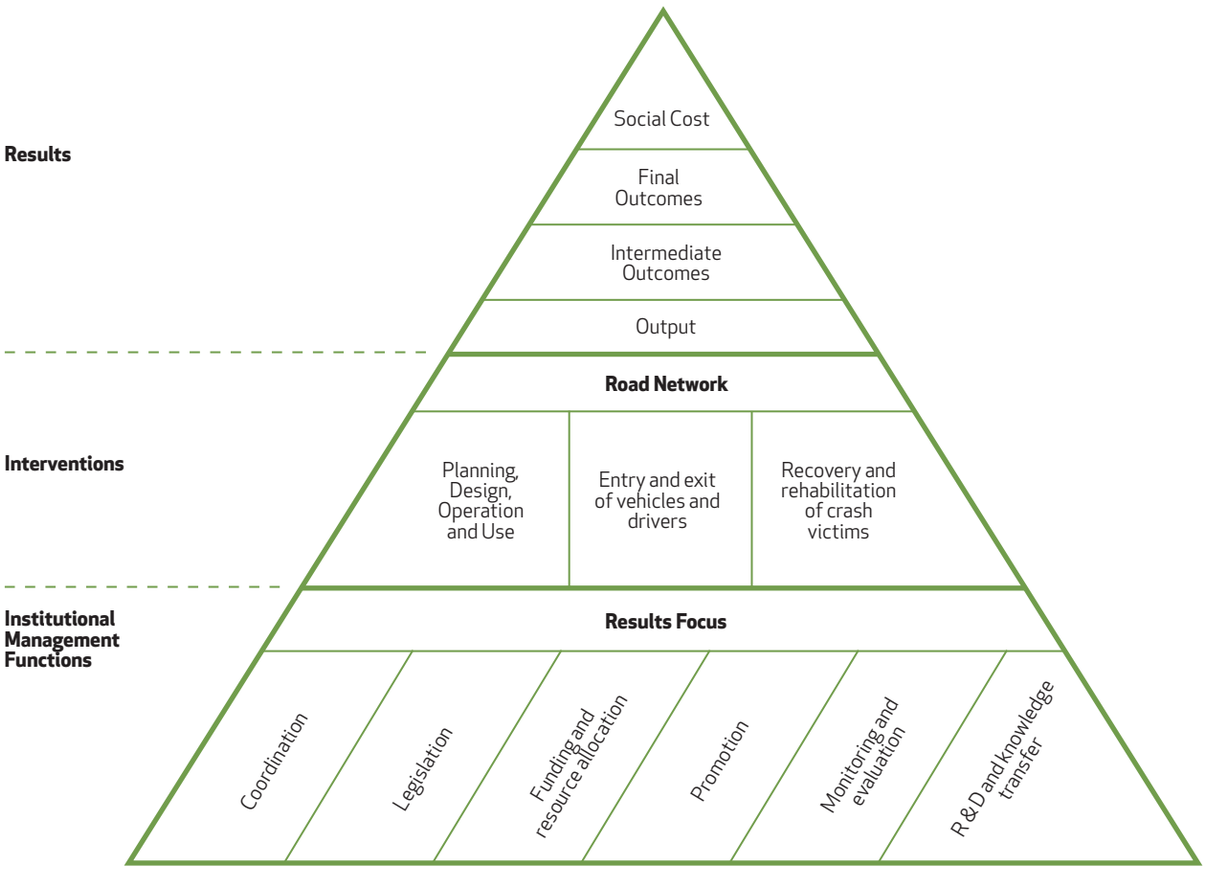
(a) Institutional structure that creates a demand for scientific work in safety issues.
(b) Formulation and enforcement of laws and regulatory requirements.
(c) Monitoring and measurement—national databases with relevant information to monitor and assess various aspects of safety policies, technologies and knowledge needs.
(d) Assuring and improving the quality of safety services provided through professionals, individual institutions and with the use of specific technologies and devices.

An example of how the Safe Systems approach can be institutionalised is given in Figure 12.7. Though this example is taken from recommendations made for setting up road safety institutional mechanisms, the approach and principles can be used for all transport systems in the planning, design, operation and use of aviation, rail or maritime networks. The same methodology applies to entry and exit of aircraft, trains and ships to these networks, and in the event of system failure, and to the management of the recovery and rehabilitation for victims from these networks.

INSTITUTIONAL SYSTEMS

Countries that have been successful in reducing transportation accident rates set up institutional mechanisms over a few decades and the results became evident starting in the 1970s. This knowledge evolved over many years through experience

Figure 12.7
Road Safety Management System



Source: Bliss and Breen (2009).

based on research, experimentation and knowledge-sharing across nations. The positive outcomes are the result of many years of capacity-building and investments by governments in institution-building and knowledge production capabilities supported by political commitment and coordination among government departments. Figure 12.7 shows the seven institutional management functions that provide the foundation on which safety management systems are built. According to Bliss and Breen, 'they produce the interventions to achieve the desired long and medium-term road safety results (expressed as a vision and related performance targets) which have been agreed across the road safety partnership at national, regional and local levels. Without effective institutional management across these functions, a country has little chance of implementing successful road safety interventions and achieving desired results on a sustainable basis. The institutional management functions are delivered primarily by the government entities producing interventions but they are also delivered in government partnerships with civil society and business entities to achieve the desired focus on results.'

The lead agency[15]:

- Plays a pre-eminent role in most of the institutional management functions
- Takes responsibility within government for the development of the national safety strategy and its results focus
- Takes responsibility for horizontal inter-governmental coordination arrangements
- Ensures vertical coordination of national, regional and local activities
- Coordinates the necessary delivery partnerships between government partners and stakeholders, the professional, non-governmental and business sectors, and parliamentary groups and committees
- Ensures a comprehensive legislative framework
- Secures sustainable sources of annual funding and creating a rational framework for resource allocation
- Promotes safety strategy across government and society

15. Adapted from Bliss and Breen (2009).

Figure 12.8
National, Prefectural and Municipal Programmes for Road Safety in Japan

Japan: Central Traffic Safety Policy Council

Source: Adapted from Kojima et al. (2012).

- Sets up systems for periodic monitoring and evaluation of safety performance, and the direction of research and development and knowledge transfer

Examples of structures of lead agencies, data collection agencies and research institutions from successful nations are given in the following sections.

ROAD SAFETY AGENCIES

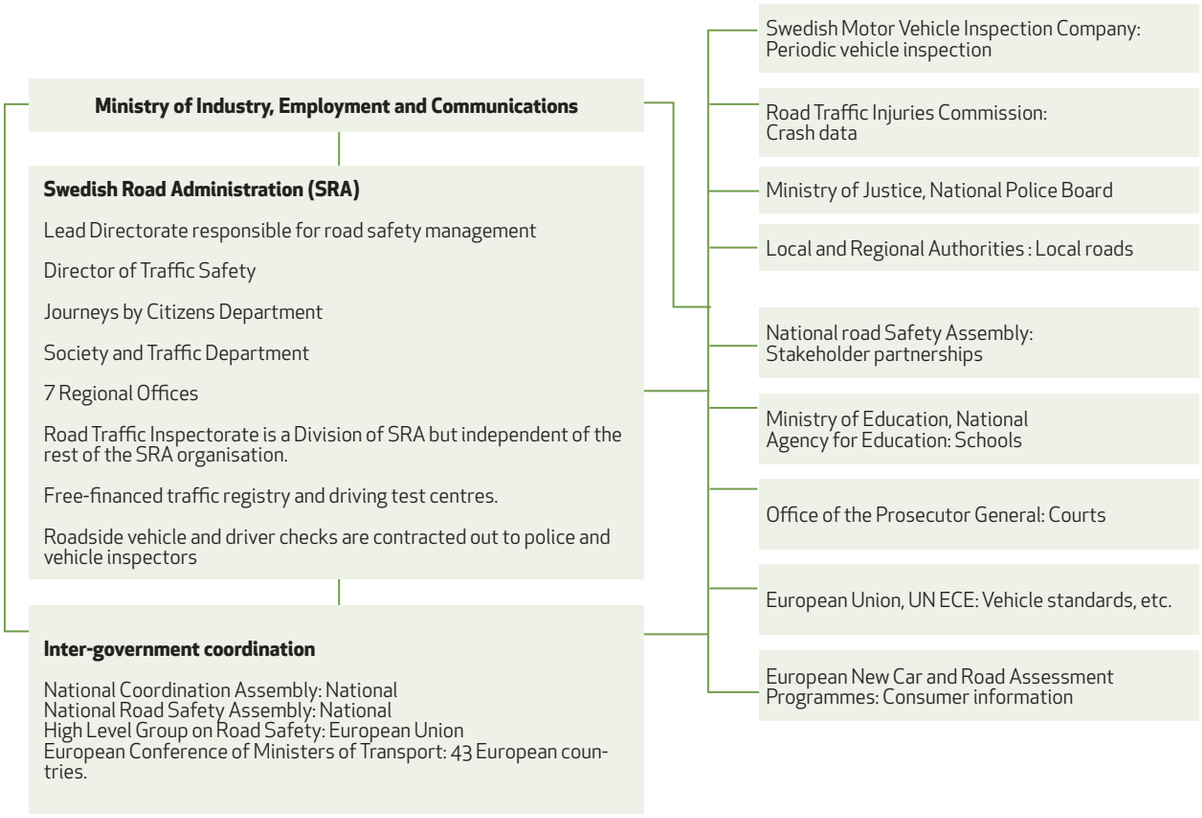
Figure 12.8 shows the institutional arrangements in Japan for promoting road safety in the country. Under the provisions of the Traffic Safety Policies Basic Act, which passed into law in 1970, the Prime Minister's Office established a Central Traffic Safety Policy Council. This Council, which is chaired by the prime minister, comprises the chief cabinet secretary, the heads of specified government agencies, and other ministers of state for special missions as named by the prime minister and is responsible for promoting the drafting and implementation of Traffic Safety Basic Action Plans[16]. The Traffic Policy Institute, which was established as part of the Prime Minister's Office in 1960, was transferred to Japan's Management and Coordination Agency in 1984. During reorganisation of the central ministries in 2001, most of the duties performed by the Traffic Safety Policy Office as part of the Management and Coordination Agency we re transferred to the office of the Director-General for Policies on Cohesive Society Planning in the Cabinet Office.

The Traffic Safety Policies Basic Act provides for the establishment of Prefectural Traffic Safety Policy Councils in each prefecture as well as for the voluntary establishment of Municipal Traffic Safety Policy Councils in municipalities that wish to establish them. These Councils are responsible for promoting deliberation on and implementation of comprehensive measures related to overland traffic safety as well as the drafting and implementation of traffic safety plans. These prefectural and municipal organisations are to establish traffic policy departments, traffic safety policy offices and other agencies as necessary, to coordinate administration and comprehensive promotion of traffic safety policies on their behalf.

Based on the incidence of traffic accidents and other criteria such as traffic volume, the Japanese government designated 'roads recognised as being particularly important to ensuring traffic safety' as eligible for 'complete or partial funding, or provision of supplemental funding, from the national government for improvements to traffic safety facilities.' The Japanese government would bear half the cost of special traffic safety facility improvement projects undertaken by the roadway administrator of national highways, prefectural roadways, and municipal roads, as well as provide supplemental funding amounting to 55 per cent of the cost of traffic safety

16. Kojima, et al. (2012).

Figure 12. 9
Organisational Structure for Implementation of Road Safety Policies in Sweden



Source: Bliss and Breen (2009).

projects undertaken on municipal roads designated as school routes by government ordinance.

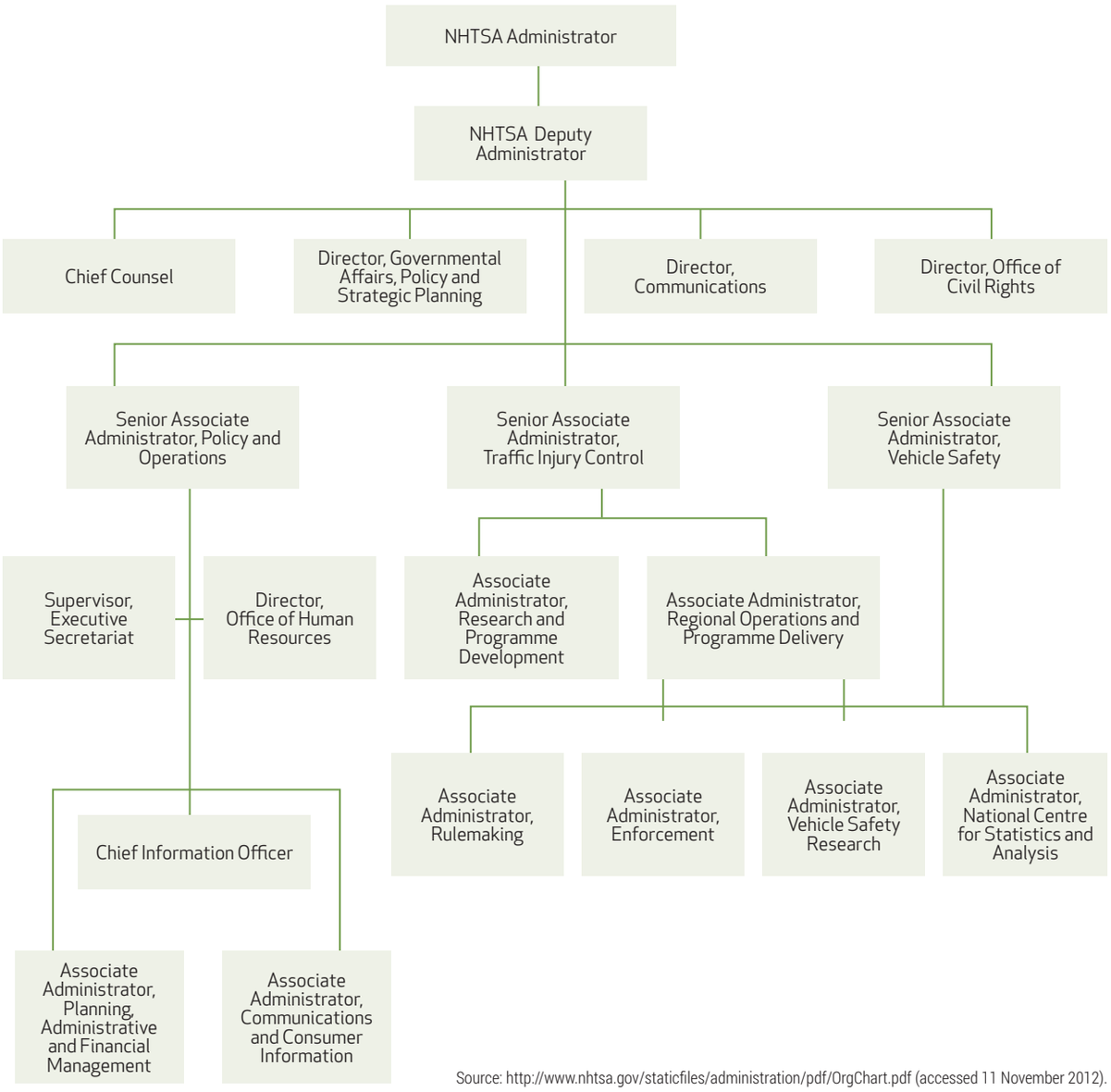
A system for traffic fines was instituted as part of the 1968 revision of the Road Traffic Act, and served as the basis for the collection of fines. Accounting procedures for these monies specified that they should be used to defray the cost of improvements to road traffic safety facilities. Specifically, these monies were to defray the cost of the installation and maintenance for road traffic safety facility projects undertaken independently by local public agencies that were designated by government ordinance, and were used for traffic signals, roadway signage, pedestrian crossings and other facilities.

Since the enactment of the Traffic Safety Policies Basic Act, the government has implemented eight traffic safety basic action plans. This has resulted in a reduction in road traffic fatalities from 16,765 in 1975 to 5,009 in 2010.

The Ministry of Industry, Employment and Communications has legal responsibility for road safety in Sweden, but the Swedish Road Administration (SRA) is the national authority assigned the overall sectoral responsibility for the entire road transport system, and the SRA is the lead agency for road safety management (Figure 12.9). The SRA is responsible for proposing national road safety goals and targets, reviewing performance and carrying out interventions in the road network. The agency also leads the Vision Zero goals through a performance agreement with the Ministry of Industry, Employment and Communications. Vertical coordination between governmental bodies, funding mechanisms for use by regional and local authorities, as well as specific road safety outputs, are overseen by the SRA.

In its capacity as road manager, the SRA is responsible for road safety on the state road network. As part of its mandate, the SRA must ensure that the construction and maintenance works contracted by it are subjected to stringent environmental demands, and encourage contractors to develop production methods that are adapted to road safety. Every head of division is to make sure that road safety is taken into consideration within his/her area of responsibility. He/she shall also endeavour to ensure that colleagues increase their awareness and knowledge about the impact of their own activities and that of the entire road transport system on road safety.

Figure 12.10
Organisation of the National Highway Traffic Safety Administration



Source: http://www.nhtsa.gov/staticfiles/administration/pdf/OrgChart.pdf (accessed 11 November 2012).

The SRA has in-house capacity to propose, ensure compliance with, and monitor road safety standards for vehicles, roads and people, as well as to provide policy advice. It establishes Commissions of Enquiry when developing and consolidating major primary legislation[17]. It is the responsibility of the SRA to establish comprehensive legislation and propose vehicle, roads and road user rules and standards. Sustainable annual funding for road safety is ensured from general tax revenues which the SRA allocates to its agencies through annual agreements and transport plans. The SRA and its partners have established databases to identify and monitor final and intermediate outcomes against targets, and the results are published annually. Safety rating programmes are used to monitor aspects of vehicle fleet and road network safety respectively. The SRA established the Road Traffic Inspectorate to help monitor road safety performance and the effectiveness of partner and stakeholder activity.

Support of research and development and knowledge transfer is a very important component of the SRA's activities and responsibilities. The agency secures funding and ensures capacity for road safety research, demonstration projects and support for attendance of its personnel at international road safety meetings, seminars, workshops and field visits. Sweden in 2010 had one of the lowest road traffic fatality rates at 2.9 deaths per 100,000 persons in the country[18].

17. Bliss and Breen (2009).
18. IRTAD (2012).

Reducing transport accident rates is usually the result of many years of capacity building and investment in institution building and knowledge production capabilities.

THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION (NHTSA), US

The National Highway Safety Bureau was created by Congress in 1966. It was replaced by the NHTSA, which was established by the Highway Safety Act of 1970. The agency directs the highway safety and consumer programmes established by the National Traffic and Motor Vehicle Safety Act of 1966, the Highway Safety Act of 1966, the 1972 Motor Vehicle Information and Cost Savings Act, and succeeding amendments to these laws. The organisation chart of NHTSA is given in Figure 12.10. NHTSA consists of just over 600 staff located in Washington DC, and in 10 regions across the United States. The agency's enacted budget for FY 2012 was $860 million of which 15 per cent was for research and development. It is one of eight administrations under the Department of Transportation. The strategic goals for the organisation are:

- Lead the effort to make traffic and motor vehicle safety a priority of the nation's healthcare agenda, and a national initiative to address the most significant traffic and motor vehicle safety issues.
- Deliver the highest quality technical and programme assistance to states and communities, and promote international cooperation.
- Improve data collection and analysis to better identify and understand problems, and support and evaluate programmes; expedite the availability of information to customers and partners.
- Support research and apply the results to education, engineering and enforcement to reduce road casualties and costs.
- Reduce the number and severity of road collisions.
- Mitigate the consequences of motor vehicle crashes.
- Advance the non-safety mandates of the Agency.
- Improve NHTSA's internal processes, management, and structure to create a more effective and efficient agency that is better able to pursue its mission.
- Listen to, involve, and serve customers and partners in the planning, programmes and activities of the agency.
- Build and maintain a professional, productive, innovative, diverse work force.
- Effectively manage and use information resources.

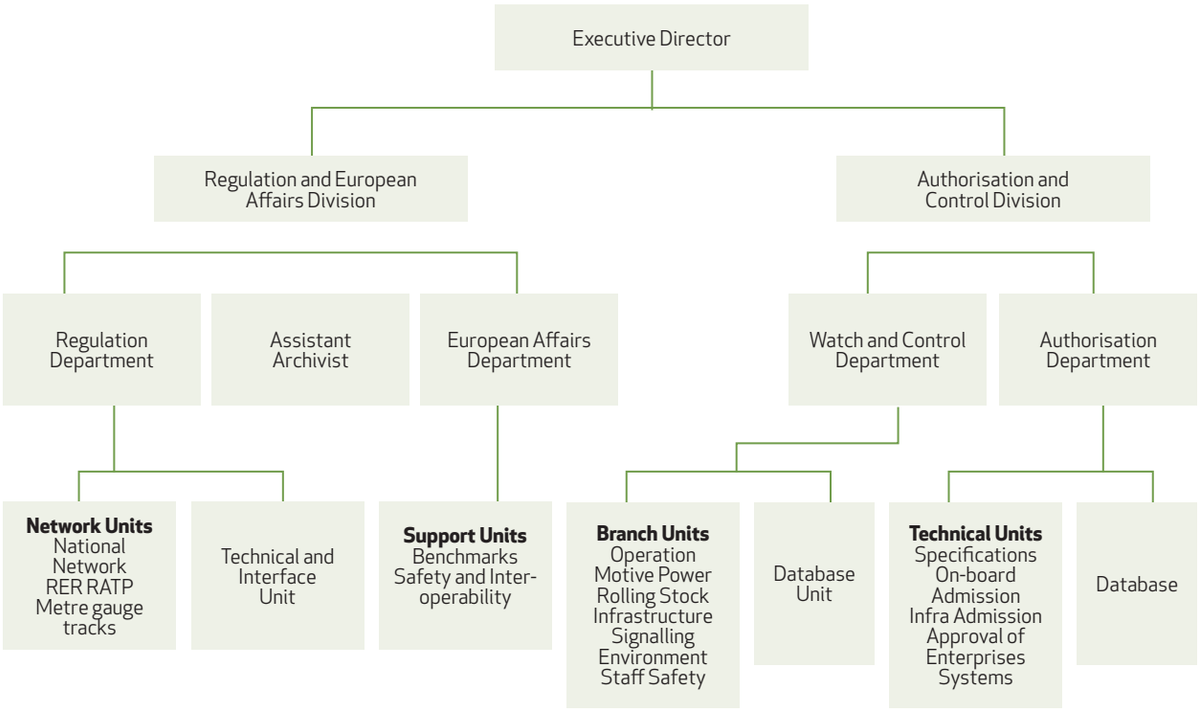
- NHTSA's activities were the following[19]: Set safety standards for motor vehicles and associated equipment, investigate possible safety defects, assure that products meet safety standards and are not defective—through recalls if necessary, and track safety-related recalls. Also enforce regulations on fuel economy, odometer fraud and vehicle theft.
- Work through state highway safety agencies and other partners to encourage safe behaviour of drivers, occupants, cyclists and pedestrians across the country: impaired driving, occupant protection, motorcycle safety, pedestrian and bicyclist safety, school bus transportation, older driver safety, national driver register, driver licensing, driver education and graduated driver licensing, speed enforcement, emergency medical services.
- Highway Safety Grant Programmes: Every state, US territory and Indian Nation, along with the District of Columbia and Puerto Rico, has an agency responsible for coordinating its highway safety programmes. NHTSA, under Section 402 of the Highway Safety Act, distributes State and community grant funds to these agencies, based on a statutory formula. The grants support highway safety plans, provide start-up money for new programmes, and give new direction to existing programmes.
- State and Community Outreach: NHTSA's 10 regional offices deliver highway safety support at the local level.
- Research and development: NHTSA conducts and sponsors a wide range of research and development projects. Examples include crash data collection and analysis, crash tests, research on human behaviour and analytical studies of vehicle components. Results of these activities are disseminated via technical reports, conferences and briefings, at workshops and public meetings.
- Keeping the public informed is a particularly important NHTSA responsibility. As the federal authority on traffic safety issues, the agency works with the national news media, the automotive industry trade press, and other sources to provide the public with information that can make motor vehicle travel much safer.

OFFICE OF SAFETY IN THE FHWA, US[20]

Within the broad highway safety mission, the Office of Safety's mission is to reduce highway fatalities by making roads safer through a data-driven, systematic approach to putting safety first when applying engineering, education, enforcement and emergency medical services. Focus areas include: comprehensive strategic planning, roadway departure,

19. NHSTA (2006).
20. Source for information: http://safety.fhwa.dot.gov/about/ (accessed 29 October 2012).

Figure 12.11
Organisational Structure of the French Public Railway Safety Authority EPSF



Source: Troadec (2006).

intersections and pedestrians safety. The office also coordinates with other DOT agencies—the National Highway Traffic Safety Administration (NHTSA), the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Railroad Administration (FRA)—to develop and implement multi-faceted, intermodal safety programmes.

The Office of Safety staff at the FHWA Headquarters in Washington DC is organised into two programme area units. Office of Safety Technologies is responsible for highway designs and technologies that improve safety performance. Major programme areas and initiatives include roadway departure, roadside hardware, retro-reflectivity, roadside safety, pavement safety, roadway systems design, intersections, geometric design, road safety audits, speed management, safe routes to school, safety countermeasure analysis and evaluation, safety performance measures and monitoring and data analysis and tools.

The Office of Safety Programmes is responsible for comprehensive federal and state highway safety programmes and activities that improve safety for all road users. Major programmes and initiatives include programme and strategic planning, the Highway Safety Improvement Program (HSIP), vulnerable road user safety, as well as coordination with external and internal safety stakeholders and advocates. The Office of Safety Programmes staff also provides customer assistance for local programmes, and support for state programmes, including policy and guidelines assistance. The Office produces a wide range of tools and technology and community resources for improving roadway user safety.

RAILROAD SAFETY AGENCY

FRANCE: ETABLISSEMENT PUBLIC DE SÉCURITÉ FERROVIAIRE (EPSF)

EPSF is the French public railway safety authority, an organisation holding all the necessary powers and competence in the field of railway safety while remaining independent of the railway operators[21]. It is entrusted with the task of issuing authorisations and ensuring, through audits and inspections, that regulatory requirements are complied with, while treating all the operators equally. It thus guarantees the homogeneity of technical and safety operating conditions and helps to enhance the interoperability of the European railway networks.

The EPSF was established by law in 2006. It is funded through a safety fee paid by railway undertakings using the national railway network and through the

21. EPSF (2009); Troadec (2006).

charges paid by promoters when asking for authorisations. This allows EPSF to use high quality means and reinforces its independence from operators. It recruits and manages its staff independently, whatever their former employment backgrounds. In 2009, EPSF had a staff of about 100 professionals. The main missions of EPSF are:

- Authorising new systems—infrastructure and rolling stock, training centres, accrediting independent experts and delivering safety certificates to railway undertakings and safety authorisations.
- Controlling the correct use of the authorisations delivered
- Publishing technical recommendations
- Coordinating relationships and setting up partnerships at the European level

The State sets the safety objectives and determines how they are to be met. It is responsible for the regulations and for ensuring that they are applied. ARAF, the railway regulation authority, makes sure that all concerned have equal access rights to the national railway network.

RFF, the owner and infrastructure manager of the network, designs and maintains the installations, handles traffic and intervenes in the event of incidents or accidents on the network. A State public authority, RéseauFerré de France has entrusted SNCF, the established French operating company, with operational management of the network.

The railway operators implement their equipment, train their staff and draw up their operating procedures and instructions in compliance with the operating regulations and documentation. They are responsible for checking application of all these rules. The emergency services also intervene to limit the consequences of accidents, especially in the case of a fire or risks involving people. The Land Transport Accident Investigation Bureau carries out inquiries in the event of railway accidents. It has a separate and complementary role to that of EPSF.

Authorisations that EPSF issues include:

- Safety certificates for railway undertakings
- Safety approvals for the infrastructure management entities
- Authorisations to put new or substantially modified systems into commercial operation
- Safety certificates for undertakings that have signed operating agreements with SNCF
- Approvals for training centres and qualified organisations
- Approvals for rail tankers carrying hazardous materials
- Specific authorisations for exceptional traffic, such as trial runs

To fulfil its mission, EPSF undertakes several types of inspections:

- Audits carried out following issue of authorisations, and programmed to make periodical and methodical checks of compliance with the conditions of issue
- Audits 'as required' if the authority's attention is drawn to repeated significant safety-related events
- Unscheduled inspections to examine specific situations

EPSF also regularly updates its database concerning the most significant safety events, which it uses to trigger its audits 'as required' and alert operators when necessary.

EPSF has also set up long-term relationships with the other European national safety authorities (NSAs) entrusted like itself, with issuing authorisations, supervising safety on their national networks, and participating in harmonisation of practices at an European level. Within this framework, cross-acceptance agreements have led to simplifications in the authorisation procedures for rolling stock.

EPSF is also entrusted with the task of drawing up and publishing technical documents, rules of good practices and recommendations concerning railway safety.

AIR SAFETY AGENCY

EUROPEAN AVIATION SAFETY AGENCY (EASA)

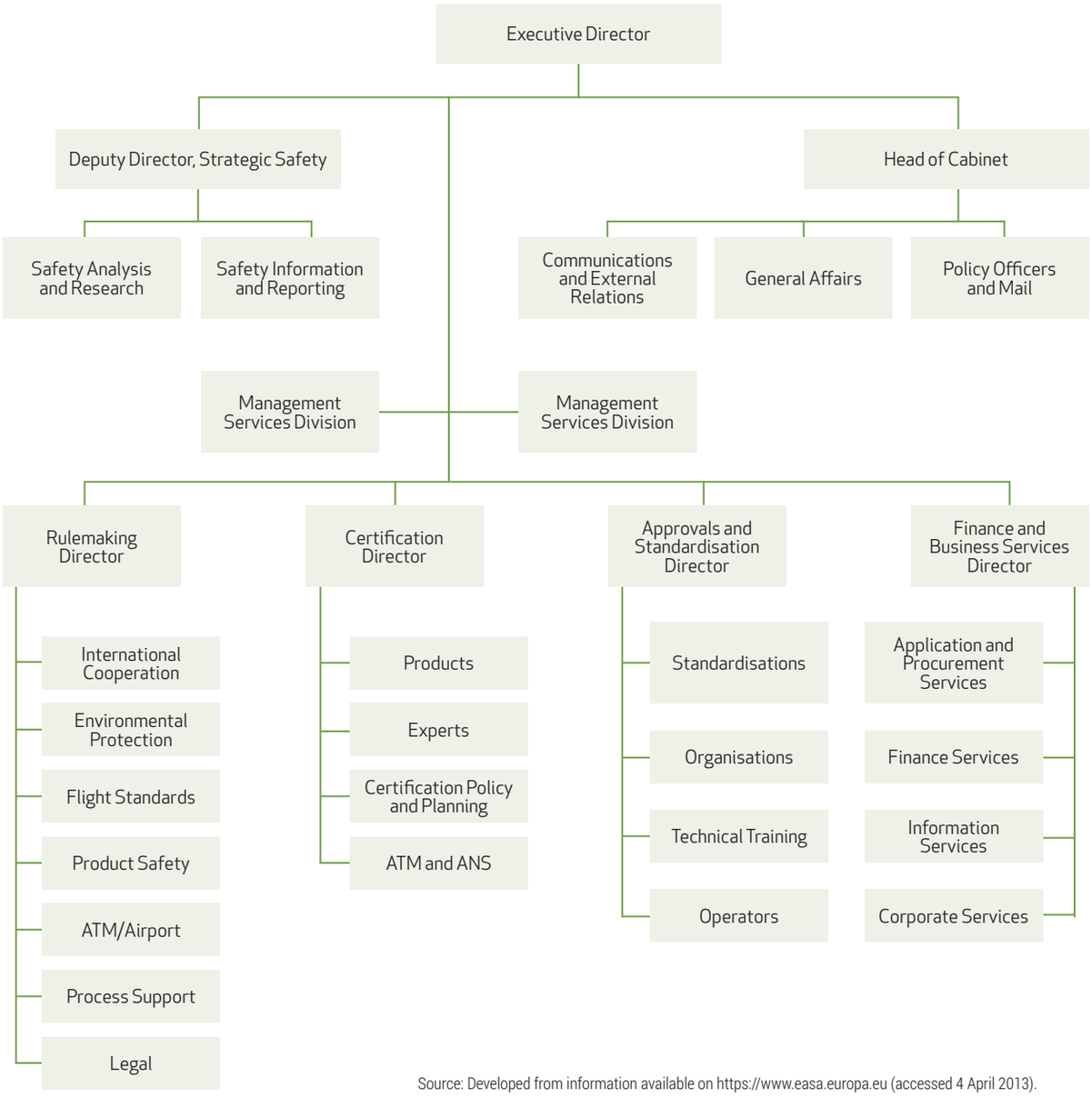
The European Union decided on a common initiative to keep air transport safe and sustainable, allowing for growth and improved safety, and established the European Aviation Safety Agency[22]. As a Community Agency, EASA is a body governed by European public law and was set up by a Council and Parliament regulation and given specific regulatory and executive tasks in the field of civil aviation safety and environmental protection. Figure 12.12 shows the structure of the organisation.

Its mission is to promote the highest common standards of safety and environmental protection in civil aviation, and develops common safety and environmental rules at the European level. It monitors the implementation of standards through inspections in the member states and provides the necessary technical expertise, training and research. The agency works hand in hand with the national authorities which continue to carry out many operational tasks, such as certification of individual aircraft or licensing of pilots.

EASA currently employs about 600 staff members and its main tasks include:

22. Source of information: https://www.easa.europa.eu (accessed 23 March 2013).

Figure 12.12
Organisation Structure of the European Aviation Safety Agency



Source: Developed from information available on https://www.easa.europa.eu (accessed 4 April 2013).

- Rulemaking: Drafting aviation safety legislation and providing technical advice to the European Commission and to member states
- Inspections, training and standardisation programmes to ensure uniform implementation of European aviation safety legislation in all member states
- Safety and environmental type-certification of aircraft, engines and parts
- Type certification of aircrafts and components as well as the approval of organisations involved in the design, manufacture and maintenance of aeronautical products.
- Authorisation of third-country—non-EU—operators
- Coordination of the European Community programme Safety Assessment of Foreign Aircraft (SAFA) regarding the safety of foreign aircraft using Community airports
- Data collection, analysis and research to improve aviation safety

The agency has been designed in order to ensure a degree of separation between the political process—the role played by the European Commission, Council and Parliament in drafting and enacting legislation relating to aviation safety—on the one hand, and the design and implementation of the technical measures necessary for safety, on the other. This explains why the Executive Director is granted independence

in decisionmaking relating to the safety issues under the agency's responsibility. This, however, is without prejudice to the chain of accountability to which the agency and its Executive Director are subject. The rules applicable to flight crew licensing (FCL) and flight time limitations (FTL) are the national rules of the EU member states.

All aircraft accidents are investigated by designated independent agencies. The safety investigation of accidents and incidents aims solely at the promotion of aviation safety, through accident prevention. It does not apportion blame or liability. Following the investigation, the published reports share the lessons learned and may contain safety recommendations for consideration.

To successfully discharge its responsibilities in this area, EASA has developed an Accident Investigation Section that is responsible for the follow-up of investigations and subsequent recommendations. Its main devoted tasks are:

- Follow the progress of aircraft accidents and incidents investigations
- Be represented in investigations and deliver technical expertise whenever needed
- Achieve the processing of safety recommendations addressed to the agency and monitor follow-up
- Provide progress reports and statistics on safety recommendations processing
- Maintain a working coordination with European accident investigation bodies
- Be aware of safety deficiencies and disseminate related information for establishing corrective actions

WATER TRANSPORT SAFETY AGENCY

UK: MARITIME AND COASTGUARD AGENCY (MCA)

MCA was established in 1998 as an Executive Agency within the Department for Transport. The Agency has an annual budget in excess of £120m, and around 1,200 staff supported by over 3,500 volunteer Coastguard Rescue Officers[23]. Operational priorities of the agency are:

- Maintaining national maritime emergency response capability, including coordination of search and rescue. The agency provides a 24-hour maritime search and rescue service
- Ensuring ship survey, inspection and certification capability, and parallel work in relation to seafarers, to meet domestic and international obligations
- Working with the maritime industry to encourage quality companies and ships to join the UK register
- Promoting improved safety among seafarers, the commercial fishing community and the recreational sector
- Supporting a successful and sustainable maritime sector through better regulation
- Working with other government departments and industry to reduce the likelihood of, and improve the capacity to deal with, pollution incidents in UK waters

The Secretary of State, or another minister designated by the Secretary of State, is responsible for the policy framework in which the agency operates and for agreeing on its strategic objectives. The minister is supported in the discharge of these functions by an Agency Advisory Board chaired by a Director General in the Department for Transport who acts as the Agency Owner. The Secretary of State appoints the Chief Executive, on the advice of the Permanent Secretary, for a fixed term, following an open competition, with the possibility of extension, subject to satisfactory performance. The Secretary of State is accountable to Parliament on all matters concerning the agency, but will not normally become involved in its day-to-day operational matters.

The investigation of marine accidents is the responsibility of the Marine Accident Investigation Branch (MAIB), which is not part of the agency. It reports directly to the Secretary of State. The agency has an operating agreement with the MAIB. The MAIB has the primary function of learning lessons to improve maritime safety. The agency may also investigate accidents but will focus its investigation on any significant breaches of legislation. The MCA works together with many other government departments, including the Department for the Environment and Rural Affairs, the Department of Energy and Climate Change, the Foreign and Commonwealth Office, the Home Office and the Ministry of Defence, to deliver its responsibilities. It also works in close partnership with the other emergency services to provide its search and rescue services.

Accident prevention work encompasses everything the Agency does in its role as a regulator, from the development of technical policy and standards, through to the enforcement of those requirements. This work includes international negotiations, primarily through the International Maritime Organisation (IMO), the European Commission (EC) and the European Maritime Safety Agency (EMSA), but also at the International Labour Organisation (ILO). Merchant ships on the UK Ship Register undergo in-depth ship surveys which cover ship construction, equipment and on-board operations. The MCA ensures that seafarers have the right skills, are medically fit, and hold valid certificates to serve on UK-registered ships. The MCA has six National Liaison Officers for various recreational activities who provide the public with information about safety messages and campaigns.

The environmental prevention work reduces pollution from shipping, and the response activities minimise

23. MCA (2010); MCA (2012).

Table 12. 4

Major Federal Safety and Activity Databases Associated with Transport Safety in the US

S No	DATABASE	S No	DATABASE
1	NTSB Aviation Accident Database	22	FMCSA Motor Carrier Management Information System (MCMIS)
2	FAA Accident/Incident Data System (AIDS)	23	FRA Rail Equipment Accident/Incident Report (RAIR) Database
3	FAA/NASA Aviation Safety Reporting System (ASRS)	24	FRA Highway-Rail Grade Crossing Incident Report (GXIR) Database
4	FAA National Airspace Incident Monitoring System (NAIMS)	25	FRA Railroad Injury and Illness Summary Database
5	FAA General Aviation and Air Taxi Activity Survey (GAATA Survey)	26	FRA Railroad Operations Database
6	Near Mid-Air Collisions System (NMACS)	27	FTA National Transit Database (NTD)
7	Pilot Deviations (PD)	28	FTA Safety Management Information Statistics (SAMIS) Database
8	Operational Errors (OE)	29	RSPA Hazardous Liquid Pipelines Accident Database
9	BTS Omnibus Survey	30	RSPA Natural Gas Gathering and Transmission Systems Incident Database
10	BTS Form 41, Schedules T100 and T100(f) Air Carrier Data	31	RSPA Natural Gas Distribution Systems Incident Database
11	BTS Form 41 T-3 passengers enplaned and other traffic data	32	RSPA Hazardous Materials Information System (HMIS) Incident Database
12	NHTSA Fatality Analysis Reporting System (FARS)	33	US Army Corps of Engineers Lock Performance Monitoring System
13	NHTSA National Accident Sampling System/ General Estimates System (NASS/GES)	34	US Census Bureau/BTS Commodity Flow Survey (CFS)
14	NHTSA National Accident Sampling System/ Crashworthiness Data System (NASS/CDS)	35	University of Michigan Transportation Research Institute
15	NHTSA Crash Outcome Data Evaluation System (CODES)	36	Trucks Involved in Fatal Accidents (TIFA)
16	NHTSA Motor Vehicle Defects Investigation Database	37	USCG Boating Accident Report Database (BARD)
17	NHTSA Motor Vehicle Defects Non-compliance Database	38	USCG Search And Rescue Management Information System (SARMIS)
18	NHTSA National Occupant Protection Use Survey (NOPUS)	39	USCG Marine Safety Information System (MSIS) Vessel Casualty Data
19	FHWA Highway Performance Monitoring System (HPMS)	40	USCG Marine Safety Information System (MSIS) Pollution Data
20	FHWA Licensed Drivers Data	41	USCG Merchant Mariner Licensing and Documentation (MMLD) System
21	FHWA/BTS National Household Travel Survey (NHTS)	42	USCG Marine Information for Safety and Law Enforcement (MISLE)

BTS = Bureau of Transportation Statistics; FAA = Federal Aviation Administration; FMCSA = Federal Motor Carrier Safety Administration; FRA = Federal Railroad Administration; FTA = Federal Transit Administration; NASA = National Aeronautics and Space Administration; NHTSA = National Highway Traffic Safety Administration; NTSB = National Transportation Safety.
Source: Adapted from NTSB (2002).

its impact. To help reduce the risk of pollution without unduly restricting legitimate activity, MCA brought into force an amendment to the UK ship-to-ship transfers regime, intended carefully to balance economic, environmental and social concerns. MCA's international negotiations have also resulted in significant changes to the regime for garbage, intended to deliver increased protection of the marine environment from ship-generated waste. MCA was closely involved in the delivery of the mandatory energy efficiency measures adopted by IMO, which have a key role in reducing emissions from the sector.

DATA COLLECTION AND ANALYSIS AGENCIES

Enactment of safety policies and monitoring effectiveness of policies and interventions requires that reliable and accurate data regarding accidents be collected and made available. All countries that have been successful in controlling death and disability due to transportation accidents have set up systems for surveillance and analysis. The institutional systems vary from country to country, but most countries adhere to the following principles:

- Establishment of agencies professionally staffed for designing and implementing data collection systems
- Ensuring compatibility of data formats between different departments and users
- Responding to the demand of lead agencies for special needs regarding availability of data

- Ensuring that all non-proprietary and non-personal data are publicly available to all concerned stakeholders
- Setting up of systems for periodic review of the efficiency of data collecting and analysis procedures and responding to new demands as they arise from time to time

The databases help in observing trends over time and for understanding the occurrence of harmful events and their relationships to characteristics of people, technologies and environments. Table 12.4 shows the major transport-related safety data systems maintained in USA and coordinated by the the Bureau of Transportation Statistics (BTS), established in 1992 [24]. The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 created BTS to administer data collection, analysis and reporting, and to ensure the most cost-effective use of transportation monitoring resources. BTS brings a greater degree of coordination, comparability and quality standards to transportation data, and facilitates in the closing of important data gaps.

BTS is headed by a Director, appointed by the Secretary of Transportation. BTS' basic authorising legislation is the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which authorised $27 million each year for a five-year period (2005-09). This funding comes from the Highway Trust Fund, and is administered within the research and development account under the Federal Highway Administration.

As a statistical agency, BTS:

- Is policy-neutral—an objective broker for the facts
- Covers all transportation; BTS is cross-modal in nearly everything it does
- Does independent data collection and analysis, but BTS also serves all the other modes to help them be more effective and efficient
- Sets standards for transportation data and has special statutory protections for the confidentiality of data it collects
- Has unique competencies in statistics, economics, information technology, geographic information systems and transportation

Over the years, BTS has established itself with a focus in three key areas, each mandated by legislation: compiling, analysing and publishing a comprehensive set of transportation statistics; making statistics readily accessible; and implementing a long-term data collection programme. BTS serves Congress, DOT, other federal agencies, state governments, metropolitan planning organisations, local governments, universities, the private sector and the general public.

The main purpose of BTS' work is to help advance DOT strategic goals. It also aims to anticipate future needs and policy issues.

NATIONAL SAFETY RESEARCH AGENCIES

Research activities regarding transportation safety are organised in different ways across nations. This activity is carried out at four levels:

1. Regional international agencies where inter-country cooperation and coordination is essential
2. National agency
3. State level agencies
4. University departments and civil society organisations

In some countries, a national research department is included within the lead agency for each transport sector, and in others, standalone safety institutions have been established. Two examples of independent national agencies are given below.

INSTITUTE FOR ROAD SAFETY RESEARCH (SWOV), THE NETHERLANDS

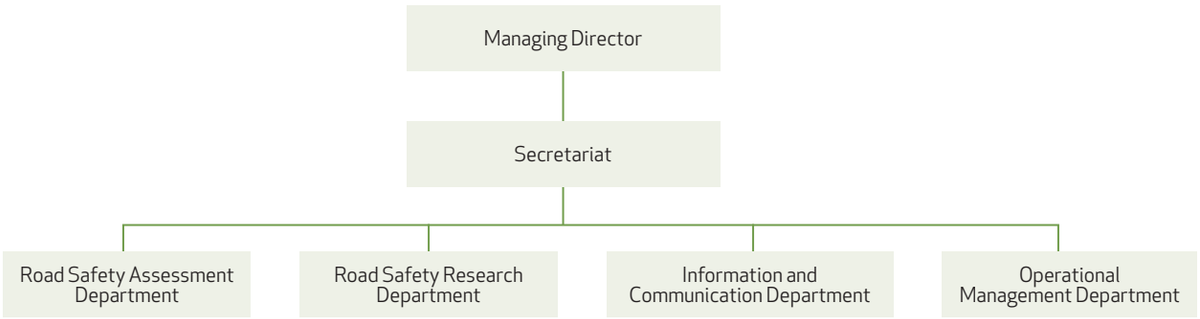
SWOV was established in 1962. The founding fathers are the Ministry of Transport and three private organisations: the vehicle industry (RAI), the motor vehicle insurance industry, and the Dutch motoring/tourist club (ANWB). SWOV is an independent institute which contributes to the improvement of road safety by using knowledge from scientific research. This knowledge is in the public domain and it is made available to anyone who is (professionally) involved in traffic and road safety, both in the Netherlands and abroad. Figure 12.13 shows the organisation structure of SWOV, which has over 100 employees.

SWOV carries out high quality fundamental and anticipatory research that can be used for practical purposes. SWOV's knowledge covers the entire range of road safety subjects. It aims at inter-disciplinary cooperation between researchers within the institute, and with other research institutions in the Netherlands and abroad. The target groups' requirements determine SWOV's activities. An essential task is distribution of knowledge and information to everybody professionally involved with traffic and road safety, both at home and abroad. SWOV's main target groups are:

- National politicians
- National, regional and municipal governments
- Advisory bodies of these governments
- Fellow researchers in the Netherlands and abroad
- Educational and knowledge institutes
- Media—parliamentary press, newspapers and professional journals

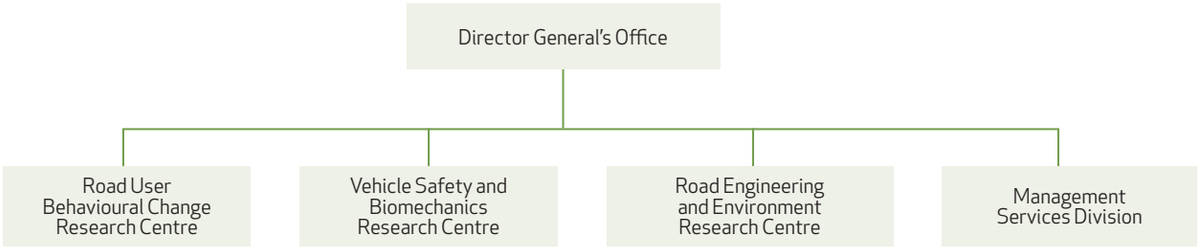
24. http://www.rita.dot.gov/bts/about (accessed 15 September 2012).

Figure 12.13
Organisation Structure of Institute for Road Safety Research [SWOV], The Netherlands



Source: Adapted from http://www.swov.nl/UK/Profiel/organigram.asp (accessed 30 September 2012).

Figure12.14
Organisation Structure of Malaysian Institute of Road Safety Research [MIROS]



Source: Adapted from http://www.miros.gov.my/web/guest/organisation (accessed 30 September 2012).

MALAYSIAN INSTITUTE OF ROAD SAFETY RESEARCH (MIROS)

MIROS is headed by a Director General and administratively organised into three Centres and one Division. The organisation structure is given in Figure 12.14.

MIROS, established in 2007, functions as a one-stop centre for the generation and dissemination of road safety information through the print media and a concerted training programme. MIROS carries out studies and evaluates current procedures on road safety to generate information that will form the core of its evidence-based intervention programmes to enhance road safety. MIROS has the following functions:

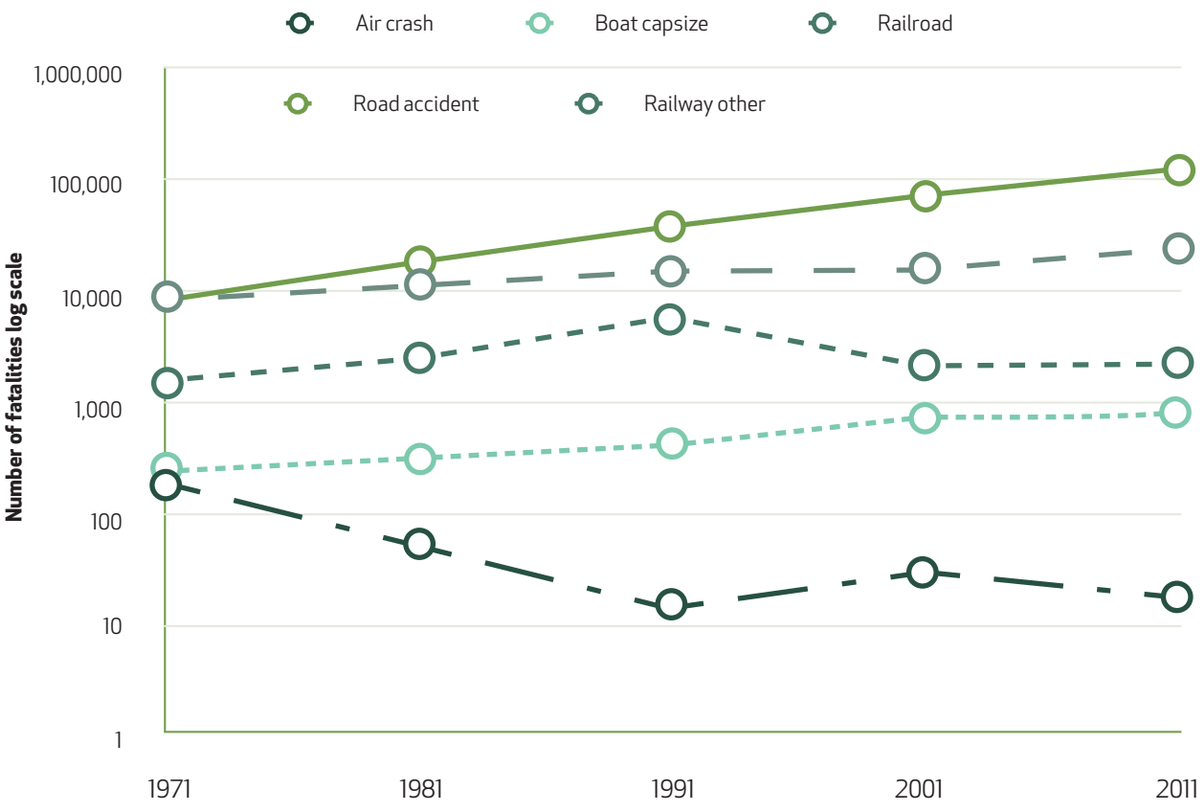
- Conduct high impact research that will be translated into road safety policies
- Develop national objectives, policies and priorities for the orderly development and administration of road safety research
- Enhance and increase knowledge based on new developments in issues related to road safety
- Serve as an audit and accreditation agency in curriculum design and standards on road safety
- Propose evidence-based cost-effective interventions/programmes
- Serve as a repository of knowledge and linkage on road safety
- Serve as a centre providing consultation and advice on road safety

CHARACTERISTICS OF LEAD AGENCIES FOR SAFETY[25]

A variety of lead agency models can be effective in road safety management, and countries must create

25. Adapted from (1) Bliss and Breen (2009). Implementing the recommendations of the World Report on Road Traffic Injury Prevention, Washington DC, The World Bank Global Road Safety Facility. (2) Report of the Committee on Road Safety and Traffic Management (2007). http://morth.nic.in/writereaddata/linkimages/SL_Road_Safety_sundar_report4006852610.pdf (accessed 4 March 2014).

Figure 12.15
Number of Fatalities in Accidents Associated with Different Modes of Transport



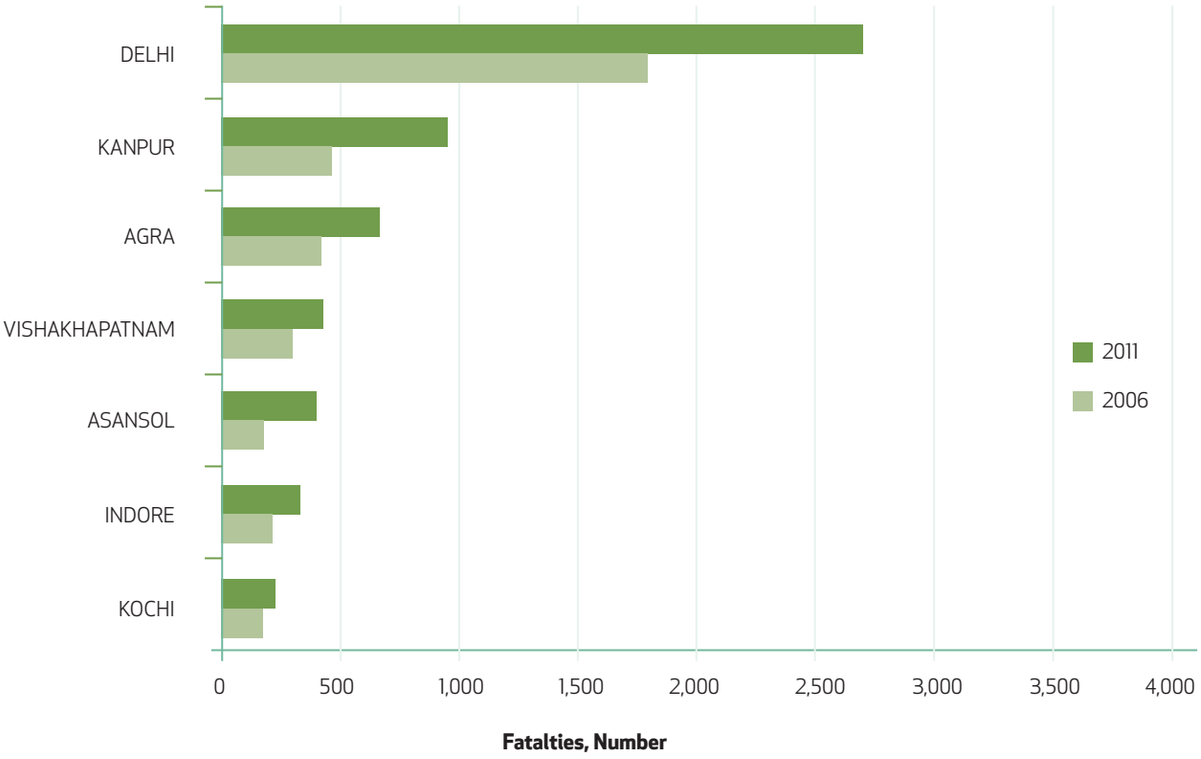
Source: National Crime Records Bureau (2012).

a lead agency appropriate to their own circumstances. Successful practice underscores the need for the agency to be a governmental body and for its leadership role to be accepted and fully supported by the rest of government to ensure appropriate funding and capacity development.

The lead agency may take the form of a designated, standalone entity with a coordinating committee representing partner government agencies. It may also be part of a larger transport organisation or be part of a Prime Minister's department. The agency might undertake much of the work itself or it might delegate aspects of work to other organisations, including provincial and local governments, research institutes or professional associations. All agencies have complex organisational structures and processes, and many partners and stakeholders. Most agencies perform all or most of the following functions:

- Set evidence-based national, regional and local safety policies, strategies and targets
- Establish systems for monitoring of progress regarding targets set and effectiveness of safety interventions
- Set performance standards for vehicles, equipment and infrastructure
- Conduct/commission safety audits of vehicles, equipment and infrastructure
- Identify subjects and institutions for research in different areas of safety, and commission and fund research projects and publish research findings, create linkages between research institutions at the local, regional and national levels
- Establish Centres of Excellence and fund safety research and education
- Establish the methodology for multidisciplinary crash investigation, data collection, reporting and analyses
- Establish procedures and systems for data collection, transmission and analysis at appropriate levels and define the role of different agencies involved in the process, and maintain comprehensive databases on safety-related issues
- Establish policies and framework for capacity building and skills among personnel of concerned government agencies, NGOs and other relevant organisations dealing with safety
- Liaise with all concerned government ministries, educational institutions, health service providers, NGOs, international agencies and organisations in other countries

Figure 12.16
Road Traffic Fatalities in 2006 and 2011



Source: National Crime Records Bureau.

working in any area related to safety and transport management

- Promote best practices in safety and transport management, undertake safety and traffic management education programmes, and conduct campaigns to create awareness on matters relating to safety
- Establish guidelines for upgrading trauma care systems at all levels and create a grid of medical, allied medical and rehabilitation facilities to provide first aid, care during transportation, emergency care in the hospital and rehabilitation
- The agency should not only set standards but also monitor their adoption and implementation. If standards are not adhered to, the agency should have powers to take corrective action.

Two important conclusions from good practices are drawn with regard to lead agency forms and related structures and processes. First, no one lead organisational arrangement is prescribed as being the best, given the diversity of country conditions which road safety managers have to meet. However, a central road safety office with adequate human, technical and financial resources is essential. Second, effective coordination arrangements are subordinate to the leadership role. Without adequate funding, technical resources and an authoritative lead agency support, coordinating the shared responsibility for achieving road safety results has little chance of success.

CURRENT STATUS IN INDIA

The time trends of total number of deaths in accidents associated with various modes of transport as reported by the National Crime Records Bureau (NCRB) are shown in Figure 12.15. Between 1971 and 2011, the total number of deaths decreased only for air accidents. The reported number of accidents in this period increased by a factor of 14.3 for road accidents, 2.7 for 'railway other', 1.5 for 'railroad' and 3.4 for boat capsize. Of the four modes of transport, accurate statistics for accident fatalities are only available for air transport (18 deaths in 2011). The number reported killed in road traffic accidents in 2011 was 136,834[26]. But road traffic accident fatality statitistics are considered to be underestimated by 15-100 per cent by different investigators[27]. The total number of rail-related fatalities in 2011 was 28,238.

26. NCRB (2012).
27. Gururaj (2006); WHO (2009).

Table 12.5
Changes in Road Traffic Fatalities in Selected Indian Cities, 2006-11 and Fatality Rates per 100,000 Persons in 2011

CITY	FATALITIES PER 100,000 PERSONS IN 2011	INCREASE IN FATALITIES 2006-11 (PER CENT)
KOCHI	36	33
INDORE	15	58
ASANSOL	69	132
VISHAKHAPATNAM	24	51
AGRA	41	56
KANPUR	34	107
DELHI	16	50

Source: National Crime Records Bureau (2012).

Table 12.6
Railway Accidents Associated with the Local Rail Network in Mumbai

ACTIVITY	FATALITIES, NUMBER	
	2003	2011
Crossing tracks	2,148	-
Falling from train	532	-
Others	127	-
Total	2,807	3,458

Source: Adapted from Krishna (2012); Parasnis (2005).

For water transport, there are no reliable statistics or estimates.

The increasing trend of accidents for water, roads and railroad is a serious cause for concern and needs special attention. Figure 12.16 shows the statistics for road traffic fatalities for selected large and small cities in India in 2006 and 2011. The data show that within a period of five years, fatalities have increased by 30 per cent to 130 per cent in these cities (Table 12.5). The range was 15-69 fatalities per 100,000 persons in 2011. This compares poorly with 4-6 fatalties per 100,000 persons per year in cities like Tokyo, London, Amsterdam, Stockholm and New York.

Urban traffic accidents are also associated with railway traffic through cities. Table 12.6 shows reported deaths on the Mumbai suburban rail network. The number is higher than the annual death toll on Delhi roads. Anecdotal evidence suggests that the number of railroad-associated injuries and deaths in other cities is also not insignificant.

It is evident that both the existing rates of fatalities are far too high and that the rate of increase in accidents is unacceptable. As shown in earlier sections, it is not necessary that accident rates increase with increase in transportation volumes in any mode of transportation if appropriate safety systems are put in place. It is imperative that we give much more importance to transportation safety in India, and this will only happen if the whole system is improved and strengthened on an urgent basis.

ROAD

The number of persons reported killed in road traffic accidents in 2011 in India was 136,834. Accurate numbers for serious injuries and disabilities are not available. Taking the 2011 number as the base, it is possible that there were about 2,800,000 hospitalisations due to serious injuries and 420,000 persons permanently disabled due to road traffic accidents in India[28]. Table 12.7 shows the road traffic fatality rates in a few countries arranged by per capita income in 2010[29]. Two fatality rates are given—one as reported by the countries, and the second estimated by the WHO, adjusted for a 30-day period for death after the crash. A negative binomial regression model was used for estimating fatalities for each country by accounting for income, exposure, risk factors and strength of the health system. For many high-income countries, reported fatality rates and estimated rates are very similar, indicating that their reporting systems may be quite reliable. This is true for only a few low-income countries; for instance, Zimbabwe and Sri Lanka. However, this does prove that it is possible to have reliable reporting systems at low income levels if appropriate arrangements are put in place.

In Table 12.7, Sweden and the UK have the lowest death rates of 2.8 and 3.1 per 100,000 persons respectively. The reported rate for India is 10.6 and estimated 18.9 per 100,000 persons. Some nations have rates greater than 30, so India ranks somewhere in the middle among countries worldwide. It is important to note that some countries with high-income levels can have high death rates—the United Arab Emirates, Saudi Arabia, the Russian Federation and some with low income levels relatively lower rates. This is ample evidence that road traffic death rates do not have a strong correlation with per capita incomes, and that economic growth does not necessarily result in lower death rates unless evidence-based safety policies are implemented.

28. Gururaj (2005); Mohan, et al. (2009).
29. WHO (2013).

Table 12.7.
Road Traffic Accident Fatality Rates per 100,000 Persons, 2010

COUNTRY	GNI PER CAPITA FOR 2010 IN US$	REPORTED FATALITY RATE PER 100,000 POPULATION	ESTIMATED FATALITY RATE PER 100,000 POPULATION
ETHIOPIA	390	3.0	17.6
ZIMBABWE	480	14.2	14.6
BANGLADESH	700	1.9	11.6
CAMBODIA	750	12.9	17.2
VIETNAM	1,160	11.5	24.7
NIGERIA	1,170	3.3	33.7
INDIA	**1,260**	**10.6**	**18.9**
SRI LANKA	2,260	11.8	13.7
ECUADOR	3,850	22.3	27.0
COLOMBIA	5,520	11.9	15.6
MALAYSIA	7,760	24.2	25.0
BRAZIL	9,540	18.7	22.5
RUSSIAN FEDERATION	9,880	18.6	18.6
SAUDI ARABIA	16,610	24.0	24.8
UNITED KINGDOM	38,140	3.1	3.7
SINGAPORE	39,410	3.8	5.1
UNITED ARAB EMIRATES	39,640	11.0	12.7
JAPAN	42,050	4.6	5.2
AUSTRALIA	46,200	6.1	6.1
SWEDEN	50,580	2.8	3.0

Source: World Health Organisation (2013).

INSTITUTIONAL SETUP

Ministry of Road Transport and Highways in the Government of India is the administrative ministry responsible for road safety efforts in the country. National Road Safety Council (NRSC), headed by the Union Minister for Road Transport and Highways is the apex advisory body. It includes the ministers in-charge of transport in the state governments and various official and non-official members. NRSC does not have adequate statutory backing, budgetary resources, professional expertise, or the mandate to be an effective organisation for executing road safety plans. The Transport Development Council chaired by the Union Minister of Transport, with the Union Ministers of Commerce, Industry, Railways and Member in-charge of Transport in Planning Commission as members, is a high level forum for the formulation of common policies for the development of road transport. It also includes all the Lt Governors/ Chief Commissioners of Union Territories and all ministers in charge of transport in the state governments. The Transport Division of the Department of Road Transport and Highways deals with matters relating to safe movement of vehicles on roads and safety awareness among users. The Road Transport Division has three sections dealing with motor vehicle legislation, transport-related matters and administration of road safety schemes. A Joint Secretary heads the Division, assisted by a Director and two Under Secretaries. The Roads Wing of the Department sets engineering standards for safety in design, construction and operation of National Highways in consultation with the Indian Roads Congress (IRC).

NCRB collects data of fatal and non-fatal road traffic accidents as reported to the police stations across the country and publishes a consolidated annual report. This is the only source for national data. However, the data is of a very rudimentary nature and as a result, we do not even have a reliable estimate of different types of road users killed. The data is not adequate for informed evidence-based detailed road safety policymaking.

At present, existing institutions are not well-equipped to deal with increasing traffic on the roads or adopt the advances in technology that would promote road safety. There are hardly any trained road safety professionals at central or state government level.

The Government of India has established National Automotive Testing and R&D Infrastructure Project (NATRiP) between the Government, a number of state governments and the Indian automotive industry to create testing, validation and research and development infrastructure in the country. The following centres have been finalised to setup the test facilities:

- International Centre for Automotive Technology (iCAT), Manesar, is the principal vehicle homologation testing agency in Northern India
- Global Automotive Research Centre (GARC), Chennai, is expected to have certification test facilities to conduct performance testing of a full range of automobiles, tractors and construction equipment vehicles. It is expected to be fully operational in 2014
- National Automotive Test Tracks (NATRAX), Indore, also expected to be fully operational in 2014, will be an automotive proving ground with test tracks for vehicle dynamics
- Automotive Research Association of India (ARAI), Pune, provides technical expertise in R&D, testing, certification, homologation and framing of vehicle regulations
- Vehicle Research and Development Establishment (VRDE), Ahmednagar, is a homologation centre belonging to DRDO and has set up a electromagnetic compatibility laboratory and a multi-function braking track
- National Institute for Automotive Inspection, Maintenance and Training (NIAMINT), Silchar
- National Centre for Vehicle Research and Safety (NCVRS), Rae Bareli, will have a full-fledged tractor and off-road vehicles test facility and a national data analysis centre

Many states have taken initiatives in promoting road safety at the local level, but none have established a professional road safety agency. Examples of initiatives include those in the states of Kerala, Punjab and Tamil Nadu, where data collection and safety programmes have been stepped up with financial assistance from the World Bank. However, there is no evidence of any significant advances yet in controlling road traffic crashes.

ACADEMIC SAFETY RESEARCH CENTRES

The Central Road Research Institute, New Delhi, has a small group that carries out research on road safety and transportation, and it is the only agency funded by the government specifically for this purpose. A Transportation Research and Injury Prevention Programme was established at the Indian Institute of Technology Delhi over a decade ago, and this is the only multidisciplinary research centre focussing on traffic safety in the country. Some research on traffic safety gets done at other Indian Institutes of Technology, National Institutes of Technology, and medical institutions, but is mainly based on individual initiative.

At present, existing institutions are not well-equipped to deal with the increasing traffic on the roads or to adopt the advancements made in techniques and technology that would promote road safety. There are hardly any trained road safety professionals employed at the central or state government level or in academic institutions. Responsibility for road safety is diffused and there is no single agency to deal with a range of problems associated with it. There is also no effective mechanism for coordinating the activities of the different agencies dealing with the issue.

RAIL

The Commission of Railway Safety, working under the administrative control of the Ministry of Civil Aviation of the Government of India, deals with matters pertaining to safety of rail travel and train operation and is charged with certain statutory functions as laid down in the Railways Act (1989), which are of inspectorial, investigatory and advisory nature. The most important duties of the Commission is to ensure that any new railway line to be opened for passenger traffic conforms to standards and specifications prescribed by the Ministry of Railways and the new line is safe in all respects for carrying of passenger traffic. This is also applicable to other works such as gauge conversion, doubling of lines and electrification of existing lines. The Commission also conducts statutory inquiries into serious train accidents and makes recommendations for improving railway safety[30].

Injuries and fatalities associated with the Indian Railways can be divided into three groups:

(1) 'Consequential accidents'. The total number of deaths in this category per year generally remain less than 1,000.

(2) Injuries sustained by Indian Railways employees while on duty. In the period 2007-08 to October 2011, there were 1,624 fatalities and 8,709 injuries in this category[31].

30. http://civilaviation.gov.in/CRSS/Commission%20of%20Railway%20Safety.html, (accessed 23 September 2012).
31. High Level Safety Review Committee (2012).

(3) Deaths and injuries among railway passengers and others on railway property not considered as 'consequential' or due to a 'fault' of the Indian railways. The number of deaths reported in this category was 25,872 in 2011[32]. According to National Sample Survey Organisation (NSSO) surveys, about 1 per cent of the Indian population suffers from locomotor disabilities, of which 26 per cent are due to injuries[33]. This means that about 3.3 million Indians are physically disabled due to accidents and about 10-15 per cent of these are associated with railway accidents[34]. However, the Indian Railways does not have any formal policy or any dedicated system for reduction of deaths and injuries.

Concerned with the high rate of railway accidents, the Ministry of Railways set up a High Level Safety Review Committee which submitted its report in February 2012[35]. The Committee noted that:

There is no practice of independent safety regulation by an independent agency separate from operations. The Railway Board has the unique distinction of being the rule maker, operator and the regulator, all wrapped into one. Commissioners of Railway Safety, though considered to be the safety watchdogs, have negligible role at the operational level. Compliance of safety standards set by Railways for themselves are often flouted for operational exigencies.

Regarding accidents not considered 'consequential', the Committee noted that :

Reluctance of Indian Railways to own these casualties, which do not fall under the purview of train accidents but are nevertheless accidents on account of trains can by no means be ignored. No civilised society can accept such massacre on their railway system.

The main recommendations of the Committee are:

1. Setting up of a statutory Railway Safety Authority (RSA) and a safety architecture which is powerful enough to have a safety oversight on the operational mode of Indian Railways without detaching safety with the railway operations. The Committee has also recommended measures to strengthen the present Railway Safety Commission to undertake meaningful regulatory inspections.
2. A Railway Research and Development Council (RRDC) to be set up at the apex level directly under the Government. This Council will have an Advance Railway Research Institute (ARRI) and five Railway Research Centres, for key safety-related railway disciplines such as rolling stock, signalling and telecommunications, motive power, tracks and bridges and operations management.
3. Elimination of all level crossings (manned and unmanned) within five years at an estimated cost of Rs 500 billion which will get recovered over seven to eight years due to savings in operation and maintenance costs, and improved train operation.

Commissioners of Railway Safety, though officially the safety watchdogs, have negligible role at the operational level. Safety standards, set by the Railways for themselves, are often flouted for operational exigencies.

ACADEMIC SAFETY RESEARCH CENTRES

At present, there are no independent academic research centres of any consequence dealing with railway safety.

AIR TRANSPORT

Safety in air transport in India is under the supervision and control of Directorate General of Civil Aviation (DGCA). As per DGCA data, India witnessed only four accidents in scheduled commercial air transport during the period 2000-2010, and non-scheduled air operations account for 22 accidents in the same period. According to the DGCA Working Group Report, 'Though regulatory framework is amended from time to time to suit immediate needs and to meet safety norms, the basic regulatory structure remains archaic. Stakeholders indicated that DGCA broadly conforms to International Civil Aviation Organization (ICAO) norms, but lacks in detailed regulatory framework which is essential for safe operations. While model regulations based on US and European regulations are available, the same have not been adopted by DGCA due to lack of in-house resources to undertake a complete review.'

The Air Safety Directorate within DGCA is responsible for all aspects of safety associated with air travel, including:

1. Investigation of civil registered aircraft incidents
2. Accident/incident prevention work
3. Approval of flight safety organisation and personnel
4. Cabin safety facilities, crew training, in-flight cabin inspection, etc.
5. Collection, maintenance and analysis of accident data
6. To coordinate with the ICAO and other aviation agencies concerning safety
7. Ensure that operators and service providers establish and maintain the Safety Management System (SMS) in their operation

32. NCRB (2012).
33. Pandey and Chatterjee (2007).
34. Singh, et al. (2009).
35. High Level Safety Review Committee (2012).

The 12th Plan envisages setting up an Air Navigation Services Corporation to manage safety, congestion and efficiency issues.

However, the shortcomings persist and in the absence of a well-staffed professional safety agency the effectiveness of DGCA has been affected by shortage of experienced manpower to oversee fast-growing aviation activities in the country. Some of the issues facing the aviation sector are:

- It is not possible to carry out meaningful audits, surveillance of a large number of airlines, non-scheduled operators, training institutes for pilots and engineers, maintenance organisations, airport service providers without adequately trained staff
- DGCA has to discharge its responsibilities of compliance with ICAO standards, approve organisations, license personnel, certify organisations, aircraft, communication systems and so on. Investigation into incidents and accidents and learning from the outcome of such investigation by implementation of the ensuing recommendations cast huge responsibilities on the regulator. However, DGCA has been crippled by the absence of the minimum required manpower, which was reduced by half over the years due to officers retiring and the organisation not being able to recruit.
- ICAO has recommended transformation of DGCA into a Civil Aviation Authority (CAA) with necessary autonomy
- The introduction of space-based navigation systems and use of satellites for navigation are on the cards. DGCA at present has limited capacity to deal with these issues
- Training facilities for various categories of aviation personnel have not yet reached a satisfactory level. While airlines are able to meet their requirements for technical training within the country, operational/flying training for many airlines is carried out abroad.
- In the General Aviation (GA, non-scheduled) sector, specialised aspects of flight training like low visibility operations, instrument approaches, performance-based navigation, etc., are not adequately addressed. The GA sector needs to be organised to introduce manufacturers' recommended training profiles, to ensure that GA pilots are as proficient in handling modern aircraft as airline pilots.
- An appellate mechanism outside DGCA, preferably in the Ministry of Civil Aviation, should be available to operators to ensure fair enforcement of regulations

The 12th Five Year Plan strategies for civil aviation include the strengthening of regulatory framework on safety and economic regulatory aspects of civil aviation, by setting up a Civil Aviation Authority and also an independent Air Navigation Services Corporation to manage capacity, safety, congestion and efficiency issues.

ACADEMIC SAFETY RESEARCH CENTRES

At present, there are no independent research centres dealing with aviation safety in India.

WATER TRANSPORT

The Director General of Shipping is the statutory maritime authority, appointed by the Government of India under the Merchant Shipping Act, 1958, and is responsible for implementation of the provisions of the Act. The Directorate General ensures implementation of various international conventions, relating to safety requirements for prevention of pollution and other mandatory requirements of International Maritime Organisation (IMO).

The Central Government is expected to verify compliance with Merchant Shipping (Management for the Safe Operation of Ships) Rules 2000 by all the companies with the requirements of the International Safety Management Code by determining that

(a) Company's Safety Management System conforms with the requirements of International Safety Management Code; and
(b) The Safety Management System ensures that the following objectives are achieved:
  (i) Compliance with mandatory rules and regulations, and
  (ii) The applicable International Safety Management Code, guidelines and standards recommended by IMO, the Central Government, classification societies and maritime industry organisations are taken into account.

Navigational Safety in Port Committee (NSPC) is expected to cover major as well as non-major ports and its duties include port navigational safety issues, cargo-related safety aspects, and oversight function of oil pollution response mechanism, reception facilities in the ports, and so on.

The Government has established an Indian Maritime University (IMU) in Chennai, with campuses in Kolkata, Mumbai, Visakhapatnam, Kochi, Chennai and Kandla. The IMU aims to play the role of a centralised nodal agency to facilitate maritime studies and research in emerging areas such as marine science and technology, and marine environment. However, it is not clear whether there is a special focus on safety at the IMU.

The Inland Waterways Authority of India (IWAI) came into existence in 1986 for development and regulation of inland waterways for shipping and navigation. The Authority primarily undertakes projects for development and maintenance of IWT infrastructure on national waterways through grants received from the Ministry of Shipping. Based in Noida, the

Authority also has regional offices at Patna, Kolkata, Guwahati and Kochi, and sub-offices at Allahabad, Varanasi, Bhagalpur, Farakka and Kollam.

It appears that there is no special agency focusing on maritime or inland water transport safety and reliable statistics regarding safety, injuries and deaths in this sector are not available.

ACADEMIC SAFETY RESEARCH CENTRES

At present, there are no independent academic research centres of any consequence dealing with water transport safety.

WAY FORWARD

Demand for better knowledge and technologies in the transport sector can only be provided by public bodies: central and state governments, and local bodies like municipalities and transit authorities. It is the responsibility of the public sector to create long-term stable demand for safety work, with the implicit understanding that progressive employment for a well-trained workforce will be available for some time to come. If respectable professional jobs become available with promising and secure career paths in safety research and operations, talented professionals will gravitate to the field. This in turn will encourage educational and training institutions to provide the programmes necessary. Thus, the problem is structural.

Institutions for road, railway, water and air transport safety need to be set up to:

(a) ensure that safety professionals in the country are abreast of international knowledge and findings
(b) provide information about the size and severity of these problems
(c) help improve our information to help prioritise problems and measure our progress in solving them
(d) gather information about strategies in situations similar to our own, and about their effectiveness
(e) ensure that evidence of the effectiveness of safety countermeasures is made part of decisionmaking at different stages, rather than just reacting to problems or political demands

NATIONAL LEVEL

ESTABLISH NATIONAL BOARDS/AGENCIES FOR ROAD, RAILWAY, WATER/MARINE AND AIR SAFETY

These Boards must be:

(a) Independent of the respective operational agencies to avoid conflict of interest

If respectable safety-related jobs become available with promising career paths, talented professionals will gravitate to the field.

(b) The CEO of the Boards should be of a rank of Secretary to the Government of India and report directly to the Minister of the concerned ministry
(c) The Boards should be staffed by professionals who have career opportunities and working conditions similar to professionals working in IITs/CSIR laboratories
(d) The Boards should have an adequate funding mechanism based on the turnover of that sector
(e) The terms of reference can incorporate the recommendations similar to those included in the reports submitted by the Committee on Roads Safety and Traffic Management[36] and the High Level Safety Review Committee on railway safety. Salient features of these two reports are given below.

a. Proposed National Road Safety and Traffic Management Board

The organisational chart for the proposed National Road safety and Traffic Management Board is shown in Figure 12.17. The structure of the Board is expected to ensure that this national agency would be able take a multidisciplinary view of the problem of road safety in India and use evidence-based systems approach for recommending safety interventions, strategies and policies in India. The following functions are proposed for the Board[37]:

(1) Road-related measures: Designing, setting standards and conducting audits
   a. Set safety standards for the design, construction and operation of the National Highways, including road infrastructure and furniture
   b. Conduct/commission road safety audits of National Highway projects through all phases (pre, during and post) to monitor adherence to prescribed standards and issue directions, where necessary, to take corrective action
   c. Recommend minimum safety standards for the design, construction and operation for roads other than National Highways
   d. Conduct/commission black spot surveys and recommend treatment
   e. Recommend traffic calming and similar safety practices
(2) Vehicle-related measures: Prescribing safety features
   a. Set standards for safety features for all mechanically propelled vehicles

36. Committee on Road Safety and Traffic Management (2007).
37. Ibid.

b. Conduct/commission audits to monitor adherence to standards
c. Set the minimum conditions for the safe usage of mechanically propelled vehicles and safety standards for vehicular traffic on various types of roads
d. Conduct/commission safety audits to monitor adherence to prescribed standards
e. Recommend minimum safety features for vehicles other than mechanically propelled vehicles and promote safe carriageways for such transport and other vulnerable road users

(3) Road safety research: Institutional linkages and training
a. Identify subjects and institutions for research in different areas of road safety, and commission and fund research projects and publish research findings
b. Create linkages between research institutions at the local, regional and national levels
c. Establish Centres of Excellence in road safety research and education
d. Establish the methodology for multidisciplinary crash investigation, data collection, reporting and analyses
e. Establish the procedure and methodology for data collection, transmission and analysis at appropriate levels and define the role of different agencies involved in the process
f. Maintain a comprehensive database on road safety-related matters

(4) Traffic laws, operations and management
a. Recommend guidelines to state governments for computerising information regarding vehicle and driver licensing
b. Recommend guidelines for training, testing and licensing of drivers

(5) Capacity Building
a. Lay down guidelines for building capacity and skills among personnel of traffic police, hospitals, highway authorities, NGOs and other relevant organisations dealing with road safety, and for training of trainers

(6) Road user behaviour strategies, public awareness and education
a. Promote best practices in road safety and traffic management, undertake road safety and traffic management education programmes, and conduct campaigns to create awareness on matters relating to road safety
b. Identify/recognise NGOs working in the area of road safety, and assist them in promoting road safety

(7) Medical care and rehabilitation
a. Lay down guidelines for establishing and upgrading trauma care systems at all levels including district hospitals and tertiary-care medical college hospitals and creating a grid of medical, allied medical and rehabilitation facilities to provide first aid, care during transportation, emergency care in the hospital and rehabilitation

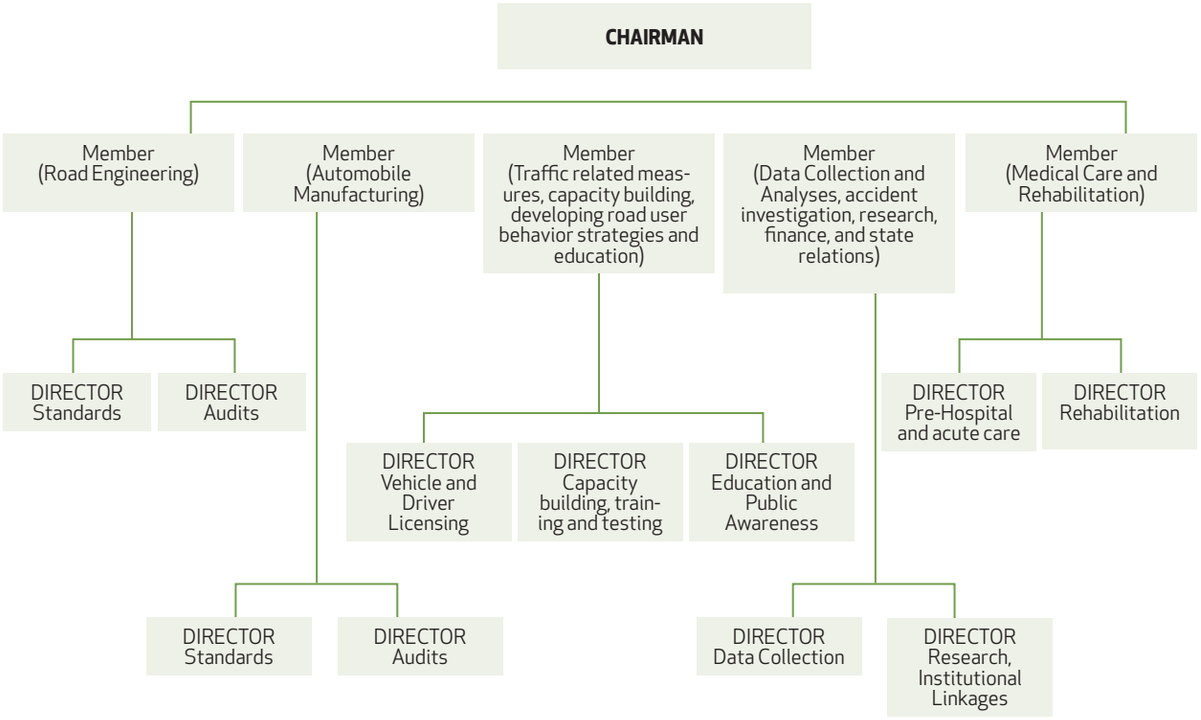
(8) Other functions
a. Advise the Central Government on road safety and on the administration of the provisions relating to safety as contained in the Central Motor Vehicles Act 1988 and rules thereunder
b. Provide technical assistance to State Boards and other agencies engaged in road safety
c. Enter into agreements with state governments on behalf of the Minister for Road Transport and Highways in the Government of India for promotion of road safety and traffic management, monitor compliance and recommend the grants to be paid to/withheld from the states
d. Liaise with other agencies like education boards and institutions, health service providers, NGOs, etc., who play an active role in matters relating to road safety
e. Liaise with international agencies and organisations in other countries working in any area related to road safety and traffic management

The Committee also recommended that the Board be given power to not only set standards but also monitor their adoption and implementation. For this purpose, the Board would empanel auditors to do spot checks and audits of highways under design, construction or operation to ensure that safety standards are adhered to. If standards are not adhered to, the Board would have powers to issue suitable directions with regard to corrective measures. The Board would have similar powers with regard to mechanically propelled vehicles, and also to seek information and reports, and access records and documents. Where standards set or directions issued by the Board have not been adhered to, the Board should have the power to levy penalties.

The Committee recommended that a minimum of one per cent of the total proceeds of the cess on diesel and petrol should be available to the Road Safety Fund of the Centre and the states, as road safety is a matter of concern not only on National Highways but also on the state roads, village roads and railway level crossings. Also, at least 50 per cent of the amount retained by the Government of India by way of the share of the National Highways and the Railways should be allocated to accident-prone urban conglomerations and states in addition to their entitlement. Assistance to the states from the National Road Safety Fund should be released provided that the states enter into agreements with the Government of India over road safety-related activities and faithfully implement the agreements.

Figure 12.17

Organisational Chart Proposed for the National Road Safety and Traffic Management Board



Source: Committee on Road Safety and Traffic Management (2007).

STATE LEVEL ARRANGEMENTS

The Committee on Roads Safety and Traffic Management also recommended that each state pass enabling legislation to set up state level safety boards with functions, powers and obligations similar to the National Board. This would be necessary in a federal set-up for implementation of safety policies and interventions that are the responsibility of the state government. In addition to the functions proposed for the National Board, the state level boards would also have the following responsibilities:

a. Liaise with the National Road Safety and Traffic Management Board
b. Specify minimum standards for design, construction and operation of roads other than National Highways
c. Specify minimum standards for establishing and operating trauma facilities and para-medical facilities for dealing with traffic related injuries on all roads other than National Highways
d. Specify minimum safety requirements and standards for the design and manufacture of vehicles other than mechanically propelled vehicles and promote safe carriageways for such transport and other vulnerable road users

MANPOWER REQUIREMENTS

International experience suggests that the proposed National Road Safety and Traffic Management Board at maturity would need at least 250-350 professionals to man the 11 departments envisioned by the Committee. Almost all these professionals would have to be post-graduates in different areas of expertise needed for road safety. This is essential for the following reasons: (a) the agency would need in-house technical expertise to keep abreast of scientific and technical advancements in road safety knowledge internationally; (b) Since the Board will have the responsibility of establishing safety standards, it is essential that its staff have domain expertise; (c) Since the Board will be sponsoring research in various areas of road safety, it would need to have professionals whose expertise is similar to those working in academic and research institutions, to establish research priorities and monitor projects.

The role of a national agency such as the one proposed above was highlighted in the World Report on Road Traffic Injury Prevention[38]. Without such an agency, accountable road safety leadership at country, state, provincial and city levels does not get established. It then becomes almost imposable to evolve sustainable policies and establish mechanisms for their implementation. The national agency will have to focus on the following objectives in the immediate future[39]:

1. Set project objectives
2. Determine scale of project investment

38. Peden, et al. (2004).
39. Bliss and Breen (2009).

Box 12.3

Checklist for Lead Agency Role and Institutional Management Functions

1. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the results focus management function?
   - Appraising current road safety performance through high-level strategic review? Adopting a far-reaching road safety vision for the longer term?
   - Analysing what could be achieved in the medium term?
   - Setting quantitative targets by mutual consent across the road safety partnership?
   - Establishing mechanisms to ensure partner and stakeholder accountability for results?

2. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the coordination management function?
   - Horizontal coordination across central government?
   - Vertical coordination from central to regional and local levels of government?
   - Specific delivery partnerships between government, non-government, community and business at the central, regional and local levels?
   - Parliamentary relations at central, regional and local levels?

3. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the legislation management function?
   - Reviewing the scope of the legislative framework?
   - Developing legislation needed for the road safety strategy?
   - Consolidating legislation?
   - Securing legislative resources for road safety?

4. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the funding and resource allocation management function?
   - Ensuring sustainable funding sources?
   - Establishing procedures to guide the allocation of resources across safety programmes?

5. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the promotion management function?
   - Promotion of a far-reaching road safety vision or goal?
   - Championing and promotion at a high level?
   - Multi-sectoral promotion of effective interventions and shared responsibility?
   - Leading by example with in-house road safety policies?
   - Developing and supporting safety rating programmes and the publication of their results?
   - Carrying out national advertising?
   - Encouraging promotion at the local level?

6. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the monitoring and evaluation management function?
   - Establishing and supporting data systems to set and monitor final and intermediate outcome and output targets?
   - Transparent review of the national road safety strategy and its performance?
   - Making any necessary adjustments to achieve the desired results?

7. Does the lead agency (or de facto lead agency/agencies) effectively contribute to the research and development and knowledge transfer management function?
   - Developing capacity for multi-disciplinary research and knowledge transfer?
   - Creating a national road safety research strategy and annual programme?
   - Securing sources of sustainable funding for road safety research?
   - Training and professional exchange?
   - Establishing good practice guidelines?
   - Setting up demonstration projects?

Source: Adapted from Bliss and Breen (2009).

Box 12.4.

An Illustrative List of Road Safety Policies and Interventions

A. DATA
- Establish nationwide online road accident recording system for police departments
- Organise road traffic injury epidemiological data surveillance system in selected hospitals
- Establish multidisciplinary fatal accident recording system teams nationwide

B. VEHICLE SAFETY
- Near future (~5 years)
  - Standards for greater conspicuity of bicycles and other non-motorised vehicles
  - Daytime running lights and anti-skid braking systems for motorcycles
  - Mandatory crashworthiness standards for all cars including ABS, electronic stability control and air-bags for all vehicles
  - Establish an Indian New Assessment Programme (NCAP) as already present in Europe, North America, Japan, Australia, China, ASEAN and Latin America.
- Longer term (>5 years)
  - Judicious selection of active safety technology for Indian conditions—adaptive speed control, emergency braking, lane departure warning, alcohol interlock, etc.
  - Pedestrian impact safety standards for all vehicles including trucks and buses
  - Establish safety standards for para-transit vehicles
  - ITS measures for communication between vehicles and road infrastructure

C. ROAD INFRASTRUCTURE
- Near future
  - Establish procedures and measures for mandatory road safety impact assessment, road safety audit, road safety inspection, black spot management, network safety management and speed management for all urban and rural roads
  - Set targets for provision of adequate universal design pedestrian and bicycle facilities on all urban arterial roads
  - Standards for provision of service and slow traffic lanes along all four-lane and six-lane highways
  - Traffic calming on all urban roads and highways passing through urban and semi-urban areas
  - Establish standards for construction of modern roundabouts in urban areas and rural roads for different traffic volumes
- Longer term
  - Establish standards for safer urban arterials including the use of ITS systems for speed control
  - All new highways to be constructed according to new safety standards established with specific consideration of local rural needs and non-motorised road users in India

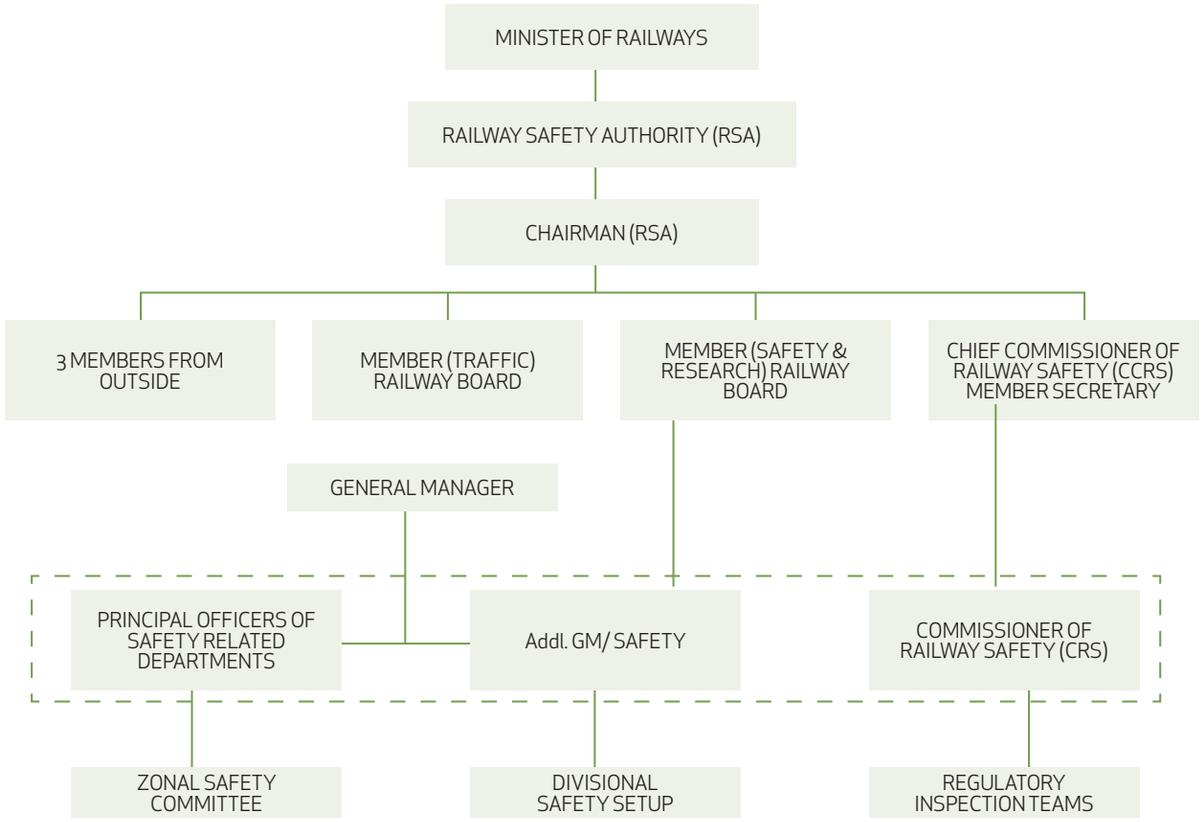
D. ENFORCEMENT AND LICENSING
  - Establish appropriate funds and policing systems to ensure nationwide enforcement of: (a) helmet use and daytime running lights by motorised two-wheeler riders; (b) seatbelt use by all motor vehicle occupants; (c) drinking and driving laws; (d) speed limits on all roads
  - Introduce Graduated Driver Licensing Systems
  - Introduce evidence based safer driver training programmes and vehicle testing systems

E. MEDICAL CARE
  - Set up one number countrywide for ambulance systems
  - Nationwide trauma care training programme for first responders, paramedics, all physicians, surgeons and trauma specialists
  - Establish advanced trauma care and rehabilitation systems in all tertiary hospitals
  - Introduce a universal insurance scheme for accident victims

F. EDUCATION
  - Educate policy makers and professionals regarding the gravity of the problem and countermeasures needed
  - Public education programme for acceptance of safety countermeasures and regulations

Figure 12.18

Organisational Chart of the Railway Safety Authority Proposed by High Level Safety Review Committee



Source: High Level Safety Review Committee (2012).

3. Identify project partnerships
4. Specify project components
5. Confirm project management arrangements
6. Specify project monitoring and evaluation procedures
7. Prepare detailed project design
8. Highlight project implementation priorities

Bliss and Breen have proposed a set of questions that can be asked to evaluate the strengths and weaknesses of a national safety agency (Box 12.3)[40]. The project implementation and research priorities will have to be developed on an urgent basis and measureable targets established for each Five Year Plan period. An illustrative list is given in Box 12.4. The measures and principles outlined for the agency can be modified appropriately for national agencies for other sectors.

b. National Railway Safety Agency

The High Level Safety Review Committee appointed by the Railway Ministry has recommended a statutory Railway Safety Authority (RSA) and a safety architecture which is powerful enough to have a safety oversight on the operational mode of Indian Railways without detaching safety with the railway operations. The Committee has also recommended measures to strengthen the present Railway Safety Commission to undertake meaningful regulatory inspections.

The Committee proposed that a Railway Research and Development Council (RRDC) be set up at the apex level directly under the Government. This Council would have an Advance Railway Research Institute (ARRI) and five Railway Research Centres, for key safety-related railway disciplines such as rolling stock, signalling and telecommunications, motive power, tracks and bridges and operations management. As a large proportion of deaths and injuries associated with railway operations occur at railroad crossings, they also recommended total elimination of all level crossings—manned and unmanned, within five years at an estimated cost of Rs 500 billion which will get recovered over seven to eight years due to savings in operation and maintenance costs and improved train operation. The project will also need setting up of a dedicated and empowered SPV for each railway zone to accomplish this task within a five-year period.

The Committee recommended that a Railway Safety Authority (RSA) should be set up as a statutory body independent of Railway Board

40. Bliss and Breen (2009).

under the Government. The Authority shall have a separate budget fully funded by the Ministry of Railways and shall be backed by a full-fledged Secretariat.

The structure of the proposed RSA is shown in Figure 12.18. RSA will liaise with the Railway Board through the Member (Safety and Research), Railway Board, and with the proposed Railway Research and Development Council. RSA will also have Zonal Safety Committees, Regulatory Inspection Teams and Divisional Safety Setup.

The Committee has proposed a total investment of Rs 25 billion over a period of five years in the Railway Research & Development Council (RRDC), Advanced Research Centres, RDSO upgradation, etc. This is in addition to Rs 1,006 billion proposed for all technical upgradation of the railway infrastructure. The Committee has recommended that a safety surcharge should be levied on rail passengers which is projected to yield Rs 50 billion annually at 2012 prices. Operational recommendations include:

- A new post of Member (Safety and Research) on the Railway Board should be created. This person will be the link between the Board, RSA and RRDC at the apex level
- The institution of Commissioner of Railway Safety (CRS) should be merged with RSA and should be strengthened and empowered. There should be a CRS for each zonal railway and each CRS should have a Regulatory Inspection Team consisting of HODs of the concerned technical departments
- Enhanced powers to be delegated to General Managers in regard to safety
- Core Safety Groups to be formed under the convenorship of the Additional General Manager (Safety)
- A High Level Task Force involving state governments and NGOs should be set up to recommend constructive measures which will alleviate or eliminate casualties due to railway infrastructure in the near future
- State-of-the-art signalling and protection system
- A national level expert committee should be constituted to establish the root cause of rail track failures
- All level crossings should be eliminated within the next five years
- Projects of importance to railway safety should be regularly awarded to select engineering academic institutions
- All officers should be periodically imparted training in safety engineering
- One training institute at the divisional level should be nominated and upgraded for training staff on the safety environment

The Government should consider establishment of an independent National Board on Water Transport Safety.

Research and development activities

- The apex body to be established, RRDC, should be chaired by an eminent technologist/scientist reporting to the Railway Minister

- Financial support up to two per cent of yearly revenue of Indian Railways should be available to support the entire research ecosystem of railways
- ARRI should be established as a high-end research organisation focusing on engineering challenges in railway-specific areas
- A string of five or so Railway Research Centres should be established which should be co-located on the campuses of Indian technological academic institutions of national importance. Each centre should specialise in specific areas like signalling, rolling stock, motive power, tracks and bridges, operations management
- The present system of only having railway officers on deputation at senior positions in RDSO should be done away with, and professionals and scientists from reputed technical institutions should also be inducted at higher levels on the permanent cadre. Their career progression should be on the similar lines as followed in other Government research institutions

c. National Water Transport and Aviation Safety Agencies

At present there are no proposals for setting up independent National Safety Agencies for water/marine transport and aviation. The lack of research and data collection/analysis capabilities in the country in these sectors is also self-evident. While aviation safety will be guided by international regulations, this may not be true for the growing private aircraft ownership and airport operations.

The Government of India should consider establishment of an independent National Civil Aviation Safety Agency and a National Board on Water Transport Safety. The latter could be headquartered at one of the major port cities with a branch in the Northeast for inland water transport safety. Both these agencies could take a similar approach as the proposed agencies for road and rail transport, and satisfy the guidelines listed in Box 12.3.

It is important that the setting up of these Boards is not delayed any further, as international evidence suggests that no country has been able to deal with the problem of safety without very strong professional institutional mechanisms.

Table 12.8
Proposed Multidisciplinary Safety Research Centres in Academic and Research Institutions

SAFETY RESEARCH CENTRES	NO. OF CENTRES	
	WITHIN 5 YEARS	WITHIN 10 YEARS
Road transport	15	30
Railroad	5	15
Marine and inland water transport	4	10
Civil Aviation	2	5

NATIONAL DATABASE AND STATISTICAL ANALYSIS SYSTEMS

At present, very little epidemiological information is available in India for deaths and injuries associated with the various modes of transport, except civil aviation. The information from the latter sector is also not available in the public domain. For evolution of evidence-based safety policies and strategies based on the systems approach, it is necessary to set up reliable data collection and analysis procedures for traffic accidents at different levels in consonance with international practices. This needs a special input for establishing special agencies in all sectors of transport. The level of effort needed is illustrated in Table 12.4 where 42 systems are listed to serve these needs in the US.

National safety agencies for each mode of transport must include a special department for data collection and statistical analysis. International experience suggests that such departments need to employ about 50-100 statistical and epidemiology experts who design surveys, data collection methods, perform statistical analyses and publish reports. It is equally important that all such data be available in the public domain so that independent researchers outside the official agency can also perform analyses and studies.

The functions of these Departments for each mode of transport could include:

- Collating relevant data from existing surveillance systems: Census Bureau, NSSO, NCRB, Central Bureau of Health Intelligence, etc.
- Establishing systems for scientific data collection by the police department
- National surveillance systems for all fatal accidents
- Sample surveys for specially identified problems
- Sample surveillance systems in identified hospitals
- Establishment of multidisciplinary accident investigation units in academic and research institutions
- Coordinating with relevant ministries and departments at the central, state and city level for collating data collected by the respective agencies

ESTABLISHING SAFETY DEPARTMENTS WITHIN OPERATING AGENCIES

Every Ministry dealing with transport should have an internal safety department (at different levels) for ensuring day-to-day compliance with safety standards, studying effectiveness of existing policies and standards, conducting safety audits, collecting relevant data, and liaison with the National Safety Agency, etc. These departments must employ 30-60 professionals with expertise in relevant areas of safety, with 30-40 per cent of the staff on deputation from the field.

Agencies operating under the Ministries (e.g., National Highway Authority of India, Airport Authority of India, Central Inland Water Transport Corporation) should also establish their own departments of safety with domain specialists. The functions of these departments would include field audits, before-and-after studies, data collection from the field, and liaison with the relevant ministry and the national safety agency.

d. Funding Establishment of Multidisciplinary Safety Research Centres at Academic Institutions

The national safety agencies in each of the transport ministries should establish multidisciplinary safety research centres in independent academic and research institutions. These centres would ideally include three or more disciplines of research, and work in each area should be pursued at three or more centres. This would promote competition among centres and is likely to result in more innovation. Safety research involves the following disciplines: relevant engineering sciences, statistics and epidemiology, trauma and medical care, sociology, psychology, jurisprudence and computer science.

For these centres to be productive, each centre should have a minimum of 8-10 professionals. It is also possible that one academic institution has more than one of these safety research centres.

The funding for each of these centres should include:

- Endowment for three or more professorial chairs
- Endowment grant for at least two post-graduate scholarships per endowed chair
- Establishment funds for critical laboratories
- Funds for supporting visiting professionals
- Support for surveys, software, travel

For these centres to function effectively, the minimum grant per centre per year would be in the range of Rs 30-40 million annually, including endowment funds. Each national safety agency should establish procedures for issuing call for proposals and for evaluating the same under open completion. A procedure should also be established for an academic peer evaluation of each centre every two years.

SAFETY POLICIES AND TARGETS

The government must announce safety policies with measurable indicators for evaluation in each sector for a five-year and 10-year period before the end of 2015.

In the area of road safety, motor vehicle standards must be in conformity with international standards and the NCAP programme in place, by 2015.

A railway safety policy covering all injuries and fatalities associated with railway property must be announced by 2015.

STATE AND CITY LEVEL

Each state must establish a Road Safety Board on the lines suggested by the Committee on Roads Safety- and Traffic Management.

Those states dealing with significant amount of water transport must set up State Water Transport Safety Boards.

Safety Departments must be established within operating agencies at different levels for ensuring day-to-day compliance with safety standards, studying effectiveness of existing policies and standards, conducting safety audits, collecting relevant data, and so on. These agencies could be state PWDs, Railway Regional headquarters, port trusts, large urban transit agencies, and municipalities of large cities. These departments must employ 50-60 per cent professionals with expertise in the relevant area of safety, and 40-50 per cent of the staff could be on deputation from the field.

The Government must announce safety policies with measurable indicators for evaluation in each sector for a five-year and 10-year period before the end of 2015.

SUMMARY

More than 166,000 persons died in transportation-related accidents in 2011 in India, or more than 450 a day. This would mean that in addition to the more than 450 deaths a day in 2011, at least 1,500 persons were disabled, 7,000 hospitalised and more than 40,000 sustained minor injuries every day in traffic-related accidents. It is estimated that the cost of road traffic crashes alone may be about 3 per cent of the GDP. The situation is quite serious and unless policies and evidence-based countermeasures are put in place urgently the situation is likely to worsen.

The existing rates of fatalities and the rate of increase in accidents are both unacceptably high. It is not necessary that accident rates increase with increase in transportation volumes in any mode of transportation if appropriate safety systems are put in place. It is imperative that we give much more importance to transportation safety in India, and this will only happen if the whole system is improved and strengthened on an urgent basis. At present, there is very little expertise, data or information available in India to address issues of safety scientifically for any mode of transport.

Significant reductions in accident rates were seen in all modes of transport in Western Europe and USA starting about the same time in the 1960s and 1970s. The reduction was probably not due to any single factor in isolation but to a wide variety of improvements in design of vehicles, operating environment and infrastructure, and enforcement of safety regulations and standards.

Transportation safety management is a systematic process in which we consider infrastructure, users and vehicles as integral components of a complex interactive system. The transport system has to be developed in a way that does not jeopardise the environment or public health and welfare. In this approach, it is essential to create an ecology that minimises the risk of transport users making mistakes and prevents serious human injury when designing, operating and maintaining the system. The entire traffic and transport system must be designed to account for the limitations and capabilities of users and operators. Since each accident is a result of a combination of human, technology and environmental factors, one cannot understand the risk factors associated with an event unless a sophisticated systems approach is followed.

Transportation safety management has seen a shift from action based on experience, intuition, judgement, and tradition, to action based on scientific research, empirical evidence, and from consideration of safety that is tacit and qualitative to consideration of transportation safety that is explicit and quantitative. The requirements of a safe system approach are:

a. Institutional structure that creates a demand for scientific work in safety issues.
b. Legislation and regulation—formulation and enforcement of laws and regulatory requirements
c. Monitoring and measurement—national databases with relevant information to monitor and assess various aspects of safety policies, technologies and knowledge needs
d. Assuring and improving the quality of safety services provided through professionals, individual institutions and with the use of specific technologies and devices

All countries that have been successful in reducing transport-related injuries and deaths have set up relatively large professional national safety agencies for each mode of transport. These agencies have different structures owing to different political and administrative systems in different countries, but are generally kept independent of the operating departments. However, most countries adhere to the following principles:

- Establishment of agencies professionally staffed for designing and implementing data collection systems
- Ensuring compatibility of data formats between different departments and users
- Responding to the demand of lead agencies for special needs regarding availability of data
- Ensuring that all non-proprietary and non-personal data are publicly available to all concerned stakeholders

The national agencies have to be supported at four levels:

a. State level
b. Departmental organisations at the local level
c. University departments
d. Civil society organisations

Demand for better knowledge and technologies in the transport sector can only be provided by public bodies: central and state governments, and local bodies like municipalities and transit authorities. It is the responsibility of the public sector to create long-term stable demand for safety work, with the implicit understanding that progressive employment for a well-trained workforce will be available for some time to come. If respectable professional jobs become available with promising and secure career paths in safety research and operations, talented professionals will gravitate to the field. This in turn will encourage educational and training institutions to provide the necessary programmes. Thus, the problem is structural.

Institutions for road, railway, water and air transport safety need to be set up to (a) ensure that safety professionals in the country are abreast of international knowledge and findings, (b) provide information about the size and severity of these problems, (c) help improve our information to help prioritise problems and measure progress in solving them, (d) gather information about strategies in situations similar to India's, and about their effectiveness, (e) ensure that evidence of the effectiveness of safety countermeasures is made part of decision making at different stages, rather than just reacting to problems or political demands.

THE WAY FORWARD

a. Establish National Boards/Agencies for Road, Railway, Water/Marine and Air Safety.
b. National Database and Statistical Analysis Systems.
c. Establish safety departments within operating agencies.
d. Fund establishment of multidisciplinary safety research centres at academic institutions.
e. The government must announce safety policies with measurable indicators for evaluation in each sector for a five-year and 10-year period before the end of 2015.
f. Each state must establish a Road Safety Board on the lines suggested by the Committee on Roads Safety and Traffic Management.
g. States dealing with significant amount of water transport must set up State Water Transport Safety Boards.
h. Establish Safety Departments within operating agencies at different levels for ensuring day-to-day compliance with safety standards, studying effectiveness of existing policies and standards, conducting safety audits, collecting relevant data, etc.

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