

**SMART, SAFE AND GREEN TRAVEL - THE ESSENCE OF BEST PRACTICE
IN DEVELOPED AND DEVELOPING COUNTRIES
(ANALYSIS BASED ON CASE STUDIES)**

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ABSTRACT

The present study focuses on multi-faceted challenges in meeting the ever-increasing demands of road transport sector and the resultant steady rise in the movements of man and materials by analyzing relevant cases in the transportation sector. The research also deliberates on the various safety aspects, social and environmental, which have a bearing on increasing number of fatalities and injuries, social stress, financial loss and environmental degradation and thus cast a negative impact on economy and society. The case study identifies the difficulties and constraints that are faced by individuals and groups in using the services of road transport system. The research also attempts to further concentrate on some of the best practices and government initiatives that have been adopted for providing better and safe road network and a system that ensures faster and safe mobility for people across the country. The study focuses on the findings of the new technologies and concepts adopted by developed and as well as developing countries in preparation of their action plan for heralding the concept of smart mobility and its implementation to improve the overall efficiency and safety of road infrastructure and also meeting the demands of increasing number of road-users. The research further highlights various green initiatives undertaken by countries like India and Tanzania and also developed countries like the United States of America and the United Kingdom in arresting environmental degradation. The paper concludes with the observations and recommendations as well as the future action plans that will enhance the road safety aspects and help in achieving safer, smarter, greener travel in our country.

KEY WORDS

Safe travel, Transport sector, Road network, Green initiatives, Smart mobility

INTRODUCTION

The expansion of road transport network is the most important prerequisite for all round development of regions thereby the country as a whole. It ensures smooth and timely movement of goods and services so as to maintain their required conditions for quality and quantity/quantum of traffic plying on the network, which in turn acts as fuels for economic and inclusive growth with overall development and also unveiling the hidden potential across the country. The improved facilities in transportation also benefit the society by enabling communities to move out freely from rural hinterlands to pockets of urban development so as to avail better healthcare, education, job opportunities, access to markets, institutions, etc. Thus, the network of surface transport is the main pillar for economic survival and social dynamics.

The expansion of transport network is a necessity for sustainable and smart mobility of people, goods and services, whereas, such connectivity also poses challenges of safety and well-being of the people on the move and in reducing negative impact on the economy. It is thus, imperative to

put in place a “safe system” in road travel, which should consist of not only by developing safety mechanism in vehicles, but facilitating positive change in the behavior of drivers and road users, improving the facilities to deal with the emergency conditions and to provide other post-crash services. The concept of safety must also encompass the aspects of environmental impact, as ‘safe travel’ must also be ‘green travel’ and ‘smart mobility’. It helps to contribute in reducing carbon footprints. This is possible only by putting in place adequate pollution control mechanism, energy planning in transport sector so as to overcome the prevailing consumption of huge amount of non-renewable fossil fuel. The mobility management strategies should have a holistic approach taking into account socio-ecological factors, environmental, economical and other associated factors thereto.

TRANSPORT SECTOR IN INDIA

Roads are the dominant mode of transportation in India today. They carry almost 90 percent of the country’s passenger traffic and 65 percent of its freight. The density of India’s highway network -- at 0.66 km of highway per square kilometer of land – is similar to that of the United States (0.65) and much greater than China's (0.16) or Brazil's (0.20).

As far as ports and airports are concerned they have inadequate capacity and often poor transport connectivity. Further with reference to transportation trains move very slowly owing to poor maintenance, and the entire railway system is grappling with issues of financial sustainability. Poor transport safety, especially road safety (138,000 road fatalities recorded in 2012, is a growing concern in a country that is adding new drivers at a record pace.

India’s transport network is one of the most extensive in the world. The share of the transport sector in overall infrastructure investments has increased from 2 percent of GDP during 1995-99 to an average of 2.6 percent of GDP between 2007 and 2011. At the same time, accessibility and connectivity are limited. Only 20 percent of the national highway network (which carries 40 percent of traffic) is four-lane, and one-third of the rural population lacks access to an all-weather road.

It is estimated that the transport sector alone will require an investment of nearly \$500 billion (3.6 percent of GDP) over the next 10 years. This is projected to be part of an overall push to stimulate overall infrastructure investments to 6.8 percent of GDP during the 12th plan and 8.0 percent of GDP during the 13th plan.

SAFETY ASPECTS OF ROAD SECTOR

Technical

The safety aspects with regard to Technical component are as follows

Existing design of road

In case of existing design of the road which is a brownfield project. In order to become improved, assessment is carried out to understand the safety aspects through geometry in design meeting the present and future requirement wherein if required realignment of the road may be carried depending on availability of land. This aspect also includes making the bypasses, structures, flyovers, underpasses, overpasses, etc.

Greenfield design of road

Greenfield road project is an advantage to plan as to meet the requirements in a more sustainable way. Since we can conceptualize and measure the requirement and can develop the design which can sustain in a long way rather than/unlike in the case of brownfield wherein compromises are carried on may be due to unavailability of land and the existence of habitations on the sides of the existing roads and other factors.

Up-gradation design of road

The up-gradation of the roads has got the component of safety looking into the speed, traffic plying on the road, congestions and other socioeconomic factors on the road. The design is made to overcome the exhausted capacity of the present design on the road. This is being done by taking due care of the safety measures built in the new up-gradation design.

Interconnection design of other road

Interconnected designs of other road wherein one of the existing road has got their capacity exhausted and parallel to it another road is made to connect them in order to provide facilities to the people, so as to reduce the congestions and to remove their chances of accidental incidents and also to enhance the economics of scale to the local people and other areas connected to it.

Social

The social aspect of the road is to connect the local people with the other destinations so as to avail facilities such as health, education, employment, to explore business opportunities, to update themselves with globalization on a real time basis. This will help to generate inclusive growth for that particular area and in the similar way linking together all the local areas in a national structure which enable growth in a uniform way wherein the various weaknesses can be removed and a continuous real growth in a sustainable way can be made possible, thereby remove social stress.

Financial losses

A proper planning by connecting various destinations in a logical way will enable to save money of the individuals and exchequers. This can be done to overcome all the physical losses as mentioned herein above like injuries, social stress, etc. With the improvement in facilities job opportunities, mobilization of business opportunities, the financial losses gets reduced and which will help to generate profitability equation considering long prospective.

Environmental degradation

Improper planning leads to loss of resources, duplication of work, overlapping of policies, misuse of funds resulting in lagging behind in the league of globalization. The most important component is to maintain biodiversity, design and construction in a planned way and it is to be processed in the most appropriate way, wherein the optimum utilization of resources is considered on priority so as to overcome existing problems of environmental degradation.

Challenges of Road sector in India

Transport infrastructure is one of the most important factors for a country's progress. Although India has a large and diverse transport sector with its own share of challenges, they can be overcome by energy-efficient technologies and customer-focused approach.

India's roads are congested and of poor quality. Lane capacity is low – majority of national highways are two lanes or less. A quarter of all India's highways are congested. Many roads are of poor quality and road maintenance remains under-funded. This leads to the deterioration of roads and high transport costs for users.

Rural areas have poor access. Roads are significant for the development of the rural areas - home to almost 70 percent of India's population. Although the rural road network is extensive, some 33 percent of India's villages do not have access to all-weather roads and remain cut off during the monsoon season. The problem is more acute in India's northern and northeastern states which are poorly linked to the country's major economic centers.

Haddon Matrix

	Human Factor	Vehicle Factor	Environmental Factor	Social Factor
Pre-crash	Information Attitude Police Enforcement	Vehicle Design Vehicle Equipment Vehicle Maintenance Speed management	Road Hazards Weather conditions Pedestrian facilities Speed limit	Enforcement Activities Insurance Incentives Driving attitudes & Habits
Crash	Use of Restrain modes Impairment	Occupant Restraints Functioning of Safety Equipment Fuel absorption	Roadside Features Crash protective Roadside objects	Restraint Laws Attitude & Knowledge about Restraint use
Post-Crash	First-Aid Skills Access to medicines	Ease of Access Fire Risk	Rescue Facilities First-Aid kits Emergency Calls	Information Sharing Emergency Services Response Trauma Care System

Pre-crash-Crash prevention, **Crash**-Injury prevention during Crash, **Post-Crash**-Life sustaining

GOVERNMENT INITIATIVES & BEST PRACTICES

- Launching the ambitious National Highway Development Program which has seven phases and which was expected to be completed by 2012. It included improved connectivity between Delhi, Mumbai, Chennai and Kolkata, popularly called the Golden Quadrilateral, in the first phase, North- South and East- West corridors in phase two, four laning of more than 12,000 km in phase three, two laning of 20,000km and six laning of 6,500 km respectively in phase four and five, development of 1,000km of expressway in phase six and other important highway projects in phase seven. Total expected investment was INR 2.2 trillion.
- Accelerated Road Development Program for the North East Region to provide road connectivity to all State capitals and district headquarters in the North East region.
- Financing the development and maintenance of roads by creating a Central Road Fund (CRF) through an earmarked tax on diesel and petrol.
- Operationalizing the National Highway Authority of India (NHAI) to act as an infrastructure procurer and not just provider.
- Improving rural access by launching the PradhanMantri Gram SadakYojana (Prime Minister's Rural Roads Program).

As per Chandigarh dateline story in TOI (July 11, 2017) which reported that for the first time in a decade, Punjab has managed to bend the fatal road accident curve with a 14% dip in number of lives lost this year, contrary to an annual increase of 6% in the previous years. Ban on sale of liquor on highways, tackling of black spots and steps taken by the local authorities during assembly polls have helped reduce the number of deaths, according to officials. As per the figures compiled by the state government, 1,765 people died in accidents in the first five months of 2017 while the number was 2,052 for the corresponding period in 2016.

"The decrease in accidents must be due to the ban on sale of liquor on highways as it curbed the tendency of impulsive buying and once drunk, the driver often ignores traffic rules. A similar trend (dip in fatal casualties) has been reported from Nagpur in news reports and it confirms that the ban had an impact," said Harman Singh Sidhu of NGO Arrive Safe that fought a legal battle for the ban on liquor vends on highways.

The Punjab cabinet had also decided to set up a Rs 100-crore Road Safety Fund, in accordance with the Supreme Court guidelines of 2016, to enhance public safety on the roads and to minimize road fatalities. The fund would be set up by diverting 50% of the compounding fee collected by road enforcement agencies, including police and transport departments. It will be on the pattern of a similar fund created by Kerala in 2007. Under the policy, the operators would also have to ensure that CCTV cameras are installed inside buses plying in the state and (those from outside) entering the state. Besides spreading road safety awareness, the fund will be utilized to enable automatic detection of over-speeding and over-loading of vehicles.

GLOBAL ACTION FOR ROAD SAFETY

A Decade of Action

The launch of United Nations Decade of Action for Road Safety 2011-2020, under the auspices of the United Nations Road Safety Collaboration (UNRSC) is an important landmark in the direction of global road safety and to prioritize it as a development and public health priority for low and middle-income countries (LMICs). The Decade aims to stabilize and reduce the number of deaths and seriously injured, by saving 5 million lives and avoiding 50 million serious injuries between 2011 and 2020. The Global Plan of Action for the Decade defines five "Pillars" of road safety:

- Pillar 1: Road Safety Management
- Pillar 2: Safer Roads and Mobility
- Pillar 3: Safer Vehicles
- Pillar 4: Safer Road Users
- Pillar 5: Post-Crash Response

Indicators have been developed to measure country progress across each of the Pillars. A recent status report 1 covering 182 countries found alarming gaps in how road safety is managed: while 89% of the countries surveyed reported having established a lead agency for road safety, fewer than 20% of them have enacted legislation across the major traffic injury risk factors. These figures serve as a baseline for the Decade of Action.

Even after launching of the United Nations Decade of Action for Road Safety, there is a widespread recognition that road traffic crashes and injuries represent an unacceptable, and underfunded, public health crisis. According to the Global Status Report on Road Safety, 1.24

million people are killed on the world's roads each year and 90 percent of these deaths occur in low- and middle-income countries (LMICs), with an economic cost that can exceed total overseas aid flowing in. Road traffic injuries are already the leading cause of death among youths and young adults between 15-24 years, ahead of malaria, AIDS and tuberculosis.

However, while the Global Fund to fight AIDS, Tuberculosis and Malaria has an approved funding of over \$23.7 billion. But, the present committed funding for road safety is far below this and meeting the international goals on road safety thus presents a tough challenge to the global community.

World Bank's Global Road Safety Facility (GRSF)

GRSF contributed to the launch of the United Nations Decade of Action for Road Safety on May 11, 2011 and leads the Bank's participation in the UN Road Safety Collaboration (UNRSC). The World Bank in its commitment to supporting the Decade of Action for Road Safety and created In 2006 the Global Road Safety Facility (GRSF), as an essential part of this effort, to help address the growing road safety crisis. The Bank established GRSF with support from the FIA Foundation for the Automobile and Society, the Government of the Netherlands, the Swedish International Development Cooperation Agency, and the Australian Agency for International Development. In 2011 and 2013, the Bloomberg Philanthropies and the UK Department for International Development also became the newest contributors to GRSF.

Since its inception, GRSF has helped the Bank move from a piecemeal approach to road safety to a more comprehensive, systematic Safe System approach in its operations. In 2008, the Bank made road safety a pillar of its strategy for the transport sector: Safe, Clean and Affordable Transport for Development. The MDB Road Safety Initiative, which was launched by the World Bank and the Inter- American Development Bank in April 2011, is also animated by GRSF. A sustained commitment by the international development community and substantial increase in donor commitments is now needed to meet the Decade goals and to move from Advocacy to Implementation.

GRSF also recognizes the role of NGOS as key partners of change and has pledged support to the Global Alliance of NGOs for Road Safety, helping over 140 countries based NGOs convince their local authorities of the need to act.

Going forward, GRSF will increase its support to programs that address the unique challenges of mixed traffic environments in a variety of investment settings through technical assistance and knowledge transfer activities across all five Pillars of the Global Plan of Action.

Indian Scenario

The Global status report on road safety 2013 estimates that more than 231 000 people are killed in road traffic crashes in India every year. Approximately half of all deaths on the country's roads are among vulnerable road users - motorcyclists, pedestrians and cyclists. A heterogeneous traffic mix that includes high-speed vehicles sharing the road space with vulnerable road users as well as unsafe road infrastructure and vehicles that are in poor condition, all contribute to the high fatality rates seen on India's roads. India is one of the countries included in the Bloomberg Philanthropies Global Road Safety Programme which is being conducted over five years (2010-2014) by a consortium of international partners together with national governments and local organizations.

GRSF at work in India

In India, GRSF funding, technical expertise and assistance have helped turn the World Bank-financed Second Karnataka State Highway Improvement Project into a good practice standard for designing holistic road safety interventions. Through a collaborative effort involving the state lead agency, World Bank Health and Transport Practices, the project aims to simultaneously strengthen institutional capacity, guide road engineers into safer design choices, improve post-impact care, bolster enforcement techniques, conduct educational campaigns, and improve monitoring and evaluation systems.

NEW TECHNOLOGIES IN ROAD SAFETY

Smart Roads applications

The use of sensors can contribute significantly to these projects by creating a series of smart applications that may lead to a better and safer world. Throughout the years, many transport infrastructures-bridges, tunnels or viaducts-have collapsed due to natural disasters or because of poor maintenance. One of the best examples is the bridge in Minneapolis in 2007 that killed 13 people and injured 145. In 2008, this bridge was re-built using a sensing system to collect data regarding structural behavior and corrosion.



The six-lane, 2.9 km CharilaosTrikoupis Bridge in Greece is outfitted with 100 sensors that monitor its condition. Soon after opening in 2004, the sensors detected abnormal vibrations in the cables holding the bridge, which led engineers to install additional weight to dampen the cables. The sensor networks for these kinds of bridges include accelerometers, strain gauges, anemometers, weigh-in-motion devices and temperature sensors. Wireless sensors can also be used to monitor the state of road surfaces. The Massachusetts Institute of Technology (MIT) carried out a research project to detect the number of potholes in a road, using Boston taxis to cover the entire city. A similar approach was undertaken by the University of Sri Lanka to monitor Sri Lanka's roads.

Additionally, monitoring systems in tunnels are also widespread around the world. From air flow to visibility, and a wide range of gases (CO, CO₂, NO₂, O₂, SH₂ and PM-10) are the most demanded parameters to monitor air quality inside tunnels. At this time, many of these systems are wired installations: the deployment of Wireless Sensor Networks would save money, increase safety and reduce installation times.



Emerging New Technologies

New technologies being developed through vehicle safety improvements, the collection of road and vehicle data, connectivity, and driving apps promise to save or improve the lives of thousands of the 1.25 million people who die and the 50 million people who are injured every year on the world's roads.

- Technology is making vehicles safer. Vehicle safety improvements, including seat belts, airbags, child safety seats, mounted brake lights, and electronic stability control, to name a

few, have saved an estimated 600,000 lives in the United States in the past 50 years. In the coming years, there will be even more of these innovations like seat belts that adjust automatically according to the impact of the crash and the size and position of the driver or passenger.

- Data collection points to best ways to reduce crashes. In most parts of the world, data about road safety and crashes is lacking. In some parts of Africa, road crash deaths may be six times higher than what is reported. Safety information, such as average driving speed, use of seat belts and child restraints, drunk driving statistics, availability of trauma care, and other data is often unavailable in many developing countries. Improvements in data collection could help analyze challenges and solve crash problems in specific locations.
- Smarter vehicles could lead to fewer crashes. Increased connectivity can alert drivers to road traffic and connect them to help in case of an emergency. In time, driverless (automated) and shared cars could significantly improve road safety, while also lowering traffic congestion.
- Drivers can reduce distractions through the help of apps such as AT&T's DriveMode. Distracted driving accounts for about 10 percent of road crash deaths in the U.S. The AT&T app aims to help drivers by silencing incoming text message (or message) alerts while in transit.

These are some more futuristic technical appliances to enhance road safety, of the many innovations which are currently in development, although some are just in the planning stage.

Radar

Manufacturers are now working on the use of new technology such as radar, which could prevent accidents in instances where speed is the issue.



New Lighting System to help maintain safe distance

One of the most exciting products currently in development is an adaptive cruise control which can help a driver maintain a safe distance between their vehicle and the one in front. If, for example, the car in front had to brake suddenly, the device would react faster than the driver and will slow the car automatically to a stop, if necessary or even restart the car depending on the surrounding traffic. This could be possible with the use of radar and a camera which would be placed behind the rear view mirror.



The camera would also be able to film a driver's behaviour, sending the information to a computer analysis system which would analyse driving performance. The camera could record and monitor behaviour associated with fatigue such as excessive blinking. If the system identifies behaviour it associates with fatigue, it will prompt the driver to take a coffee break.

Curbing Drunk Driving

To tackle the problem of drunk driving, some manufacturers are currently marketing systems which would prevent a car from starting until the appropriate reading is recorded in an on-board breath analyzer.



New Lighting System to avoid dazzling the other driver

One of the most surprising inventions is a new lighting system. Whilst we are familiar with the technology which allows lights to turn and move in relation to turns in the road, manufacturers are currently developing full headlights which do not dazzle other drivers. In fact, the light beam will adapt to the environment. Put simply, if a vehicle arrives in front, the left side of the beam will automatically lower its brightness, if a car is overtaking a vehicle then the central part of which will lower its brightness to avoid dazzling the other driver.



System of Digital Support Systems to avoid accidents and dangerous situations

The other surprising innovations that are expected to emerge in few years include support systems to help drivers avoid accidents and dangerous situations, or at the very least help them to lessen the consequences. For example, manufacturers have developed the e-Call system. Designed in the form of a small box, the e-Call system is able to detect impact and thus provide relief. It could also raise an alarm, if it detects an obstacle or potential collision and uses smart technology to measure the distance to the car in front.



Global road safety projects in India

The overall goal of the Bloomberg Philanthropies Global Road Safety Programme in India is to support the Government of India to implement good practices in road safety in line with the national road safety strategy. The focus of the project is on promoting motorcycle helmets and reducing drink-driving. The project is being implemented in: Hyderabad, Cyberabad and Visakhapatnam

The combined population of these focus areas is nearly 13 million people.

WHO-supported activities

In the context of the project in India, WHO assesses legislation and advises on possible improvements, develops social marketing campaigns and measures their impact, hosts workshops for journalists, and provides road safety equipment to local implementers. The Global Road Safety Partnership trains the police on enforcement and supports NGOs in their advocacy efforts, while Johns Hopkins University conducts monitoring and evaluation activities.

In 2012 WHO conducted a review of existing laws and regulations within the Government of India's Motor Vehicles Act, with a particular focus on drink-driving and motorcycle helmet wearing. Two proposed legislative amendments have been stalled in Parliament – one an amendment to the Motor Vehicles Act which proposes to increase fines for road traffic violations as well as address post-crash care, and the other to set up a lead agency for road safety.

Given this, WHO activities focus largely on advocacy for action by the Government to adopt recommendations for amending the Motor Vehicles Act. In December 2013 WHO supported hosting of a High-level Meeting on Road Safety to enhance advocacy for the proposed amendments.

Green Initiatives in India, USA, UK and Tanzania

To move to a greener, low carbon economy, both systemic improvements and specific technological solutions have been undertaken in the countries around the world.

In India, The National Electric Mobility Mission Plan 2020, promoted use of hybrid and electric mobility by having about 6-7 million electric/hybrid vehicles, and saving about 2.2 – 2.5 million tonnes of fuel by 2020. In January 2013, a concrete policy proposal was adopted. Mahindra Reva, an initiative by Mahindra Group, was India's first automatic and electric 2- door car. Now, Government is also planning to bring 7M Electric Vehicles on road by 2020.

The National Policy on Biofuel, 2008, has earmarked blending of biofuel (ethanol and biodiesel) up to 20 per cent by 2017. Several manufacturers now offer 'Flex-Fuel Vehicles' or 'FFVs', which can run on any percentage of bioethanol blend up to E85. Biodiesel is also now commercially produced by the 'esterification' of energy crops such as oil seed rape or from waste vegetable and animal oils (from the food industry). The Bureau of Indian Standards (BIS) has already evolved a standard (IS-15607) for Bio-diesel (B 100), which is the Indian adaptation of the American Standard ASTM D-6751 and European Standard EN-14214. India, having the highest population of cattle has also the capacity to producing BioCNG more than 4.0 mill. T of LPG per year, as a suitable substitute for fossil fuels.

A Green Urban Transport Scheme has been adopted to follow the low Carbon path for implementation in cities each with a population of five lakhs and above and all capital cities with a Central assistance of about Rs.25,000 crore in the next five years.

In the USA, The Department of Transport (DOT) in its Sustainability Policy Statement in 2014, stressed upon carriers to minimize the environmental impact and make use of green opportunities. UPS, which operates the industry's largest private alternative fuel fleet, tops in the green initiative with more than 2,000 compressed natural gas, liquefied natural gas, propane, electric, and hybrid electric vehicles. The carrier recently ordered additional green vehicles expected to reduce emissions by 20 percent and improve fuel economy by 10 percent compared to the cleanest diesel engines available today.

SmartWay, another innovative program, developed by the Environmental Protection Agency (EPA), a voluntary partnership between shippers, carriers, intermediaries, is also acting on improving fuel efficiency and reducing greenhouse gas emissions.

Another new initiative jointly undertaken by the Environmental Protection Agency (EPA) and DOT, to increase average vehicle fuel efficiency to roughly 54.5 miles per gallon by 2025 is being implemented. The Federal Transit Administration (FTA)'s National Fuel Cell Bus Program continues to develop commercially viable fuel cell bus technologies to improve fuel efficiency. DOT research is also focusing on engineering obstacles to the development of alternative fuels pipelines and materials compatibility issues for ethanol and biodiesel pipelines.

In the UK, the Department for Transport had adopted a number of sustainability targets, like reducing greenhouse gas emissions by 80% of 1990 levels by 2050, while 22% of those emissions come from the domestic transport sector, of which 94% were from road transport.

It has created a Sustainable Travel Access Fund to encourage walking and cycling and also a carbon reduction plan with the use of ultra-low emission vehicles(ULEV). The Department is investing over £600 million over the next 5 years to achieve the aim for almost every car and van to be a zero emission vehicle by 2050. The ULEVs should have a 9% share of the market by 2020 to follow the most cost-effective path to meeting the UK's 2050 decarbonisation target

which includes transport emissions falling to around 81 MtCO₂ by 2025, a 31% reduction from the 2014 sector emissions.

The Department also has a plan, to procure 15% of its overall energy consumption, including 10% of its transport energy consumption, from renewable sources in 2020.

Dar Rapid Transit (DART) Agency in **Tanzania** had launched a Campaign from 2009 on the use of cleaner fuel to considerably reduce the sulphur content in fuel quality. In the year 2000, the sulphur content in petroleum fuels was 2,500 particles per million (ppm). In 2014, it was 50 ppm., which has considered as a great achievement. The Government of Tanzania has also made achievement on bulky importation of petroleum fuels with restricted set standards of the sulphur content less than 50 ppm.

The DART system is to also use BRT buses technology to maintain emission standards with the use of appropriate vehicle technology and Euro III emission class technology that meets the set standards for diesel. The use of lower sulphur fuels will improve engine life and lower maintenance costs, reduce vehicle emission and greenhouse gases and improve public health.

Government of Tanzania (GoT) is also focusing on the use of Compressed Natural Gas (CNG) in vehicles which is almost emission free.

RECOMMENDATIONS

- An innovation needs to be carried out to bring a new kind of device which can easily be fitted in the vehicle so as to calculate the distance in automated mode considering the minimum safety aspect, indicating the other vehicle on road.
- In order to overcome the difficulty of assessment in regard to the vehicle which is coming from the back and trying to overtake (in a speed over and above 80-100 km/hr) technology is to be innovated to take care of safety measures to the vehicle running in the front.
- Promotion at all the levels to provide auto sensors /cards so that vehicle crosses the Toll plaza paying automatically through the auto sensor card.
- Easy access to be provided at adequate intervals to cyclists and domestic animals on roads.
- To overcome the major accidents, suitable geometrical design needs to be provided for the Highways of roads.
- The accountability for the construction, operation needs to be taken care in real sense and standards, norms and codes are to be modified as per the change in requirement. The same should be legally incorporated in policy, guidelines, etc.
- The environmental code of practice and green initiatives should be adopted to avoid or minimize the adverse environmental impact on the road network.
- Active participation is required from government, non-profit organizations, bureaucrats, academicians, students, community and the people should be involved to improve the Road maintenance and Management systems in the country.

CONCLUSIONS

- Safety aspects are inbuilt in new traffic and transportation mode which eliminates and reduces the chances of accidents.
- Safe technology also provides to get aware about the system of travelling and educate the continuous changes thereof on real time basis. This enables the change in behavior without much inconvenience to the beneficiaries.
- Regular improvements in implementation achieves reduction in cost of construction, manufacturing, productions and services of various kind involved in the activity of transportation. An appropriate integration of all the provisions of updations as and when required leads to saving in cost, optimum utilization of resources, timely reach out to the destination and accomplishing socio-economic wants with availing the maximum benefits.
- There should be transparency at the stage of planning and during its implementation. The policies, legislations and enforcement should be as per the site specification, requirement of communities, geographical areas and environmental components.

Way Forward

Smart Roads applications are about to come to our lives, and most of them will improve our quality of life. According to Logan Ward in Popular Mechanics, American drivers log nearly twice as many kilometers as they did 25 years ago on roads that have increased in capacity by only 5 percent. The annual costs of traffic congestion keep rising, resulting in 3.7 billion hours of driver delays and 8.7 billion liters of wasted fuel. A smart road may also be able to warn the travelers of an alternative route to avoid traffic congestion a few kilometers away in near future.

Road traffic fatalities are one of the most important causes of death globally.

According to the World Health Organization (WHO), more than 150,000 people will be killed on the roads by 2020, since cars will be more present in developing countries, increasing the number of vehicles on the world's roads up to 2 billion.

Weather conditions affect road safety - therefore, the use of sensors and smart applications could reduce the number of road accidents. Smart Roads could take advantage of solar energy for power, clearing city streets of ice and snow by simply melting it away. Furthermore, temperature-responsive dynamic paint could be used to make ice crystals visible to drivers when cold weather makes road surfaces slippery.

Smart Lighting could also be applied to Smart Roads by fitting the roads with power-saving lights that gradually brighten as vehicles approach then switch themselves off after they pass. In fact, a photo-luminescent paint for road markings is about to be used in the Netherlands. This paint would charge during the day to illuminate the tarmac for up to 10 hours overnight.

Taking into consideration that road accidents have reached alarming levels in India, it is important to initiate necessary action to improve the road conditions and to educate the road users. Several countries have demonstrated how road safety standards can be improved through a well-articulated road safety vision, sustained effort and investment. And the pay offs for these efforts can be exceptionally rewarding. While it is anticipated that road accidents cost India three percent of its GDP we cannot afford to lose any life at any day at any cost.

Considering the fact that there are multiple factors involved in road safety domain in my forthcoming research I would like to take up the most important component in the management of Roads i.e. Road Users' Behavior: in terms of programs undertaken for change of behavior of drivers (compliance with driving norms), cyclists and pedestrians (adhering to safe use rules); and case studies on successful initiatives and road safety programs.

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