FICCI

Paving future roads for India

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Infrastructure Advisory

CRISIL
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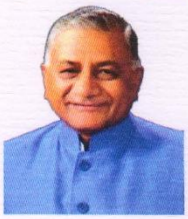
PVSM, AVSM, YSM (Retd)



सत्यमेव जयते

राज्य मंत्री
सड़क परिवहन एवं राजमार्ग मंत्रालय
भारत सरकार, नई दिल्ली

Minister of State for
Road Transport & Highways
Government of India, New Delhi

MESSAGE

India has the second largest road network in the world at 58.98 lakh Km, out of which around 1.32 lakh Km are National Highways. The focus on road and highway construction industry is expected to grow for the next five years. The government has taken ample initiatives in the recent past to tackle concerns related t land acquisition, revival of languishing projects, introduction of innovative project financing and time bound resolution of disputes in an affordable manner. Government initiatives like Bharatmala and Pradhan mantra Gram Sadak Yojana (PMGSY) have been instrumental in creating a network of roads that connect all cities and villages.

The government is committed to construct efficient roads and highways to cater to the growing demand of developing sustainable infrastructure for the future. The increase in the number of road vehicles and the subsequent rise in traffic volumes and axle loads speed up developments like congestion, wear and tear of structures and air pollutions have led to adopting of new and innovative technologies which are long lasting and cost effective. The government has constantly emphasized on usage of more innovative techniques and materials for faster and better quality construction of roads and highways.

I congratulate FICCI and CRISIL for preparing a white paper "Paving Future Roads for India" which take us through the evolution of road construction industry in India.

The conference on New and Emerging Technologies in Road Construction is held at an opportune time to gain better understanding of the emergence of newer technologies which are durable, sustainable and environmental-friendly.

I wish the conference all the success.

[General (Dr.) V. K. Singh]

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Foreword from FICCI

Mr Krishna Prakash Maheshwari
Chairman, FICCI National Committee on Infrastructure and Chief Executive Officer (Roads, Railway, Metro Railway, Water & Waste Water)
Adani Infra India Limited

India has the second largest road network in the world. Project awards and construction in the roads and highways sector have significantly increased in recent years, highlighting the present government's thrust on the sector. Usage of innovative materials, automation and machine control technologies in the construction sector is encouraged both by government and private sector to improve efficiency and lower the impact on environment.

With this background, a comprehensive report – "**Paving Future Roads for India"** has been prepared by FICCI and CRISIL to be released at the **Conference on New and Emerging Technologies in Roads Construction** organized by Federation of Indian Chambers of Commerce and Industry. The report also touches upon building smart highways to improve operations and management of road infrastructure.

I hope this report will help to analyze the potential business opportunities for private sector in the Indian Roads and Highways sector.

We welcome your suggestions and feedback.

Foreword from CRISIL

Mr. Jagannarayan Padmanabhan
Director and Practice Leader
Transport & Logistics
CRISIL Infrastructure Advisory

Roads have always been vital infrastructure for a country as they enable efficient transportation of freight and people. With higher thrust on infrastructure development over the last couple of years, the road construction industry in India is undergoing a paradigm shift. Robust demand, higher investments and significant policy support are changing the face of the sector.

New and emerging technologies are reshaping the dynamics of road construction with a renewed focus on sustainable development. Such technologies offers various benefits to all stakeholders, including road users, the authority/government, concessionaires and developers. These technologies include use of improved materials for road construction such as recycled materials, plastic wastes, self-healing asphalt, etc. In addition, the usage of automation and machine-control technologies is growing rapidly, prompting the equipment manufactures to bring in advanced and intelligent road construction technologies to improve the quality of construction. Further, advanced technologies in highway development and management, such as project monitoring information systems, intelligent transport management systems and advanced traffic management systems, enable project monitoring, higher traffic efficiency, real-time vehicle tracking and incident management.

The Ministry of Road Transport & Highways (MoRTH) and National Highways Authority of India (NHAI) have been leading the adoption of new and emerging technologies in the sector from the front. Some of the flagship initiatives driven by the government in the sector includes, but are not limited to, use of plastic waste in bituminous pavement construction; use of project monitoring information systems (PMIS) for real time project tracking and monitoring; and electronic toll collection via FASTag. However, with rapid growth in the sector and increasing traffic, further improvement in applied technologies will be required to counter the various challenges that exist in the sector such as cost overruns, safety issues, blocks to land acquisition, flaws in design and planning, environmental concerns, etc. Many researchers and scientists in India and around the world are currently working on new and improved innovative technologies in road construction. In some cases, various advanced technologies are being tested as pilot projects around the world and require further research and analysis for conceptualisation.

Executive summary

India has the second largest road network in the world. The present government, recognising the importance of the sector, has significantly increased the award of projects to construct new roads and highways. Moreover, the government and industry players have been actively taking initiatives to improve the quality and user experience in road construction. Initiatives, such as electronic toll collection (ETC) and use of plastic in pavement construction, are being taken to improve efficiency and service delivery in the sector.

Road development in India received an impetus with the launch of the National Highways Development Project (NHDP), under the aegis of the National Highways Authority of India (NHAI) in 1999. Further, the introduction of the Pradhan Mantri Gram Sadak Yojana (PMGSY) in the late 2000 started the process of connecting rural hinterland with various important financial centres and cities of the country.

The present government is working on implementing several road development projects such as the Bharatmala, Setu Bharatam and Char Dham Highway project. Furthermore, technological advancements and some ingenious inventions are enabling execution of the most complex road projects in a timely and eco-friendly manner, with lower project lifecycle cost.

The three phases in any major construction project are *a)* planning and design; *b)* construction; and *c)* operation and maintenance. Considering the various challenges that exists in the road sector, this report discusses the use of new and emerging technologies in the following three aspects of the project lifecycle:

i. Road construction materials and machines
ii. Design and implementation
iii. Highway operations and management

The technological advancements made in each of the above areas of road construction and development are elucidated in the report.

For road construction and development to have a sustained growth, the projects should be able to achieve the following three parameters: *a)* they should be environment friendly; *b)* they should have faster construction rate; and *c)* they should have a more efficient lifecycle cost management. However, achieving all the three simultaneously for a project may be difficult. It can achieve either two with an adverse impact on the third or, in some cases, only one.

Thera are a number of new and emerging technologies that can help a project achieve the above three parameters. For instance, use of plastic waste in bituminous pavement has numerous advantages such as higher resistance to deformation, increased durability and improved fatigue life and better stability and strength. Self-healing concrete and intelligent compaction are other emerging technologies in the area of road construction materials and machines. Smart highways, intelligent transport management solutions, advanced traffic management systems, project monitoring information system, etc. are some of the notable technological developments that can improve the operations and management.

In order to tackle the increasing traffic load on Indian roads and to overcome various challenges such as cost overruns, new materials, processes and technologies will have to be developed further. For this, the government should encourage more research and development in these areas. However, cost, bureaucratic interferences and sustainability are some of the major concerns that can potentially drive or obstruct applicability of such technologies.

Background

Introduction

At 58.98 lakh km, India has the second largest road network in the world. Of this, 1.32 lakh km are National Highways (NH).[1] Project awards and construction in the roads and highways sector in India have significantly increased in recent years, highlighting the present government's thrust on the sector. The length of National Highways awarded during fiscals 2015-2018 was almost double that was awarded in fiscals 2011-2014, while rate of construction increased 70%.[2] However, measuring the progress with these raw numbers may not give a complete picture. For instance, despite the increase in the road length, the quality is not up to the mark. The quality of construction varies widely across the country. The government and sector leaders recognise this and have been taking initiatives such as ETC, use of plastic in pavement construction, etc. to improve efficiency and service delivery.

Project lifecycle and trend in road construction technologies

Brief history of road construction in India

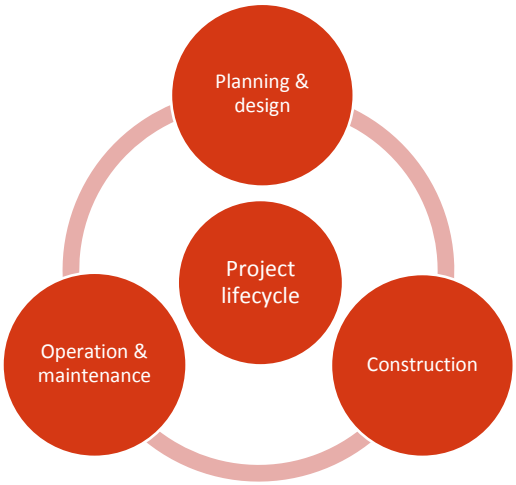
With many hinterland having no proper road connectivity, road construction has been a focus area in India both pre- and post-Independence. Parliament passed the National Highways Authority of India (NHAI) Act in 1988 "to provide for the constitution of an Authority for the development, maintenance and management of national highways and for matter connected therewith or incidental thereto". The sector received an impetus with the launch of the National Highways Development Project (NHDP) in fiscal 2000. The project came under the responsibility of NHAI. Subsequently, the government also launched the Pradhan Mantri Gram Sadak Yojana (PMGSY) in late 2000, aimed at constructing all-weather roads connecting villages with major financial centres and cities in the country.

The present government is working on implementing several road development projects such as the Bharatmala, Setu Bharatam and Char Dham Highway project. Technological advancements and ingenious inventions are enabling timely completion of complex and environment friendly road projects at lower cost, effectively resulting in a transformation of the road sector.

Challenges faced during the project lifecycle in the road sector

Road construction materials and machines	Design & implementation	Highway operations and management

All construction projects have broadly three phases:



Industry players are working to bring new technologies and resulting efficiencies in each of the above areas. Some of the

[1] NHAI

[2] Achievement of Four Years, MoRTH

major challenges the sector faces are congestion, project delays and difficulty in monitoring large complex projects. A major challenge during the construction phase is cost overrun. Until three years ago, the per-km cost of developing a two-lane highway was Rs 11- 12 crore and that of four-lane Rs 30 crore. This has cumulatively gone up 30% over the last three fiscals.[3] Safety, environment degradation and low productivity are some of the other challenges in the sector.

Key areas of advancement

New and emerging technologies in the road construction and development are expected to help a project achieve the following objectives:

i. Making the project environment friendly
ii. Faster construction rate
iii. More efficient lifecycle cost management

However, achieving all the three simultaneously may be difficult for a project. It can achieve either a combination of two with an adverse impact on the third or, in some cases, only one. For instance, use of advanced technology can quicken the rate of construction and lower the project lifecycle cost but at the same time may impact environment adversely.

[3] An article on Cut road construction costs: Road Ministry to NHAI, Daily Pioneer, October 18, 2019

Road construction materials and machines

Context

Usage of innovative materials, automation and machine control technologies in the construction sector is encouraged worldwide in order to improve efficiency and lower the impact on environment. Developed countries are already seeing benefits of this, such as higher productivity, controlled costs, high rate of predictability, efficiency, quality, safety etc. In addition, it is also helping them keep projects on track and complete them in time, that too at higher quality standards. In India, construction is one of the least automated industries. However, now attempts are being made to introduce new technologies in the sector.

Some of the recent advancements in use of materials and equipment in road construction are:

Use of plastic waste in bituminous pavement

In 2015, the Centre made it mandatory for all road developers to use plastic waste for construction. The move came after Rajagopalan Vasudevan, a professor from Madurai's Thiagarajar College of Engineering, developed a process to build roads by recycling plastic waste. This is one of the few innovations that is completely home-developed. As per the process, plastic waste is first shredded (a technique where all the dust particles are eliminated, and plastic items are shredded into fine pieces), and heated at 165°C. This is then added to the bitumen mix, which is also heated at 160°C. This mix is used for constructing roads.

Field performance studies have found the process to be advantageous as the roads constructed using this mix have higher resistance to deformation, increased durability, improved fatigue life and better stability and strength. Moreover, the process is also a way to dispose of plastic waste in a way that is less harmful to environment.

By 2018, India built one lakh km of roads in at least 11 states using discarded plastic.[4] The Ministry of Road Transport & Highways (MoRTH) has embarked on a mission to utilise waste plastic in a big way. It has mobilised nearly 26,000 people for spreading awareness on plastic waste management. Nearly 18,000 kg of plastic waste has been collected from across the country through over 61,000 hours of *shramdaan*. On a pilot basis, NHAI used plastic waste in laying the top layer of roads in Tamil Nadu and Kerala.[5]

Figure 1: A 600m service road stretch on the Bengaluru-Hyderabad highway using 4% plastic waste

Self-healing asphalt

Road repair and maintenance is a costly job. In fiscal 2020, MoRTH allocated Rs 3,150 crore for maintenance of roads and highways, which is 17% higher than the revised estimates for fiscal 2019. In addition to this, NHAI, National Highways & Infrastructure Development Corporation Ltd (NHIDCL), state public works departments and other road agencies spend a much larger amount for maintenance. In order to reduce potholing and cracking of roads, scientists are developing ingenious and unconventional methods to improve durability. Rather than improving the strength of the road, scientists are focusing on asphalt with the ability to heal itself once damaged.

[4] NDTV article on plastic roads in India dated 26th October, 2018
[5] PIB, Ministry of Road Transport & Highways dated 1st October, 2019

Some of the materials used by scientists around the world in developing the self-healing asphalt are:

Steel fibres

Adding steel fibres to asphalt ensures that once it is worn out and cracks/potholes appear, it only needs repair. Iron molecules are heated remotely by introducing a fast-changing magnetic field. Once heated by induction, the steel fibres immediately release heat to the mortar, which melts briefly. This causes the asphalt to reset to its original structure.

Iron oxide nanoparticles

Researchers at Swiss Federal Laboratories for Materials Science and Technology in Switzerland -- and ETH, Zurich, also have a similar technology. They use iron oxide nanoparticles in self-healing asphalt instead of steel fibres. These nanoparticles heat up upon exposure to a magnetic field. In place of induction machines, maintenance vehicles outfitted with magnetic coils are used to introduce heat that starts the healing process. Once heat is transmitted to the bitumen, it softens and fills the cracks.

Capheal (sunflower oil microcapsules)

The use of the caphael formula was developed by Alvaro Garcia, Lecturer at the University of Nottingham. The method involves inserting sunflower oil microcapsules into asphalt, which reduces the binder's viscosity and helps the asphalt heal. Once tiny cracks appear, the microcapsules burst and soften the asphalt around them and helps binding. This method fixes cracks before they grow.

The benefits of self-healing asphalt include:

- Minimal repair costs as the self-healing asphalt only requires minimal repairs and replacement
- The asphalt mixed with steel fibres reinforces the road surfaces causing fewer cracks to appear thereby increasing road durability.
- Less traffic hindrance as there is less work required on the roads to carry out repairs
- Self-healing technology enables faster repairs during the operation and maintenance phase

Self-healing roads withstand heavy rains[6]

In 2016, Nemkumar Banthia, professor of civil engineering at the University of British Columbia, constructed a road in the small town of Thondebavi, outside Bangalore, Karnataka. He used a technology that resists heavy rains, intense heat and poor drainage (another home-grown technology in use in the sector). The technology involved usage of ultra-high strength concrete reinforced with hydrophilic polyolefin fibres (also called HY5 fibres) with advanced nano-coatings. This concrete formulation is more resistant to cracking and more able to heal itself of cracks. The project used 60% lesser cement component, replacing it with locally sourced fly ash, a by-product of thermal power plants.

Bitumen – Role and recent advancement

Majority of the Indian roads are flexible pavements, where bitumen is used as a common binder. The one major advantage of a flexible pavement is that their surfaces can be milled and recycled during repair and maintenance phase. In India for decades Hot Mix Asphalt with bitumen aggregate has been used as Pavement mixes. However, with technological advancement and focus on sustainable development, usage of cold mix bituminous emulsion is picking up the pace around the world and in India as well. Some of the major advantages of cold mix bitumen are energy savings, pollution-free environment, safer working condition for labor at construction sites, etc. as there is no requirement of high temperature while mixing and laying of bitumen.

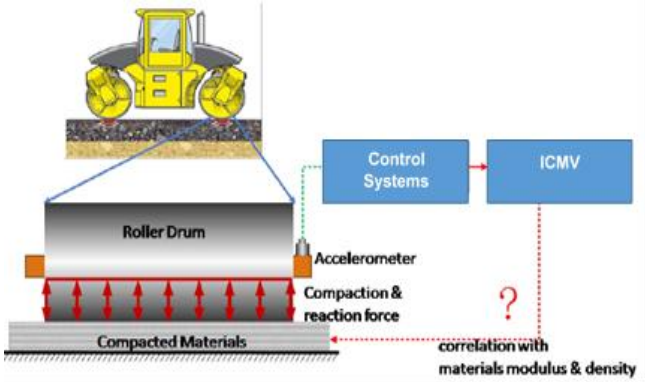
[6] An article of self-healing roads in ubyssey.ca, November 15, 2016

Intelligent compaction measurement values (ICMV)

Intelligent compaction (IC) is an equipment-based technology to improve quality control of compaction. IC vibratory rollers are equipped with a high precision global positioning system (GPS), infrared temperature sensors, an accelerometer-based measurement system, and an on-board color-coded display. ICMV is a generic term for a calculated value based on accelerometer measurements on vibratory roller drums. These values are in different forms of metrics with various levels of correlation to compacted material's mechanical and physical properties.

The figure below illustrates how ICMV is measured:

Figure 2: Illustration of ICMV measurement



However, the complexity of roller material's interaction makes it challenging to produce accurate results and further research is required to enable the use of ICMVs in the road sector. ICMV offers several benefits such as improved depth of compaction, lesser highway repair costs and better density, which would significantly improve the lifecycle cost.

Quickchange moveable barriers (QMB)

Many factors contribute to traffic congestion. It has been a major challenge for India. The number of vehicles plying on an Indian road is much beyond its capacity. One possible solution for this can be changing the number and availability of traffic lanes by use of QMBs.

The QMB is an innovative system that prevents tail-backs at road exits, allowing rapid movement of the safety barrier delimiting motorway deviations and lanes. In the US, the QMB system is used for both construction sites and fixed plant, where the flow of commuter traffic is in different directions in the morning and evening. The system involves a machine that shifts the barrier sideways at a rate of 9 and 15 km/h.

Figure 3: Quickchange Movable Barrier

Design and implementation

In planning the development and construction of a road, it is important to recognise the close relationship between design and implementation. Technological advancements made in this area have quickened the speed of construction and lowered the project lifecycle cost. Some of the design and implementation advancements made in the road sector are discussed below.

Precast pre-stressed concrete pavement

In India, precast pre-stressed concrete technology is widely used in construction of bridges, flyovers, viaducts, tunnels etc. However, precast concrete systems in road construction too have huge potential to transform the road repair and maintenance in heavy-traffic areas. Concrete roads are seen to be more durable and will bring down the cost of road maintenance significantly. Implementation of such precast concrete systems also paves the way for exploring new technologies for faster construction of cement concrete roads. Foremost among the options available was precast concrete technology.

K Rajarama Rao, *chief general manager – materials, Nagarjuna Construction Company Ltd, states, "Prefabrication of any structure component off-site during highway construction or reconstruction offers major time and user cost savings in comparison with traditional cast-in-place methods of construction. The precast road pavement technology offers dramatic increase in durability and speeds up construction process. It also brings substantial safety advantages, lower disruption in traffic and increases overall convenience for road users."*

Perpetual pavement

Sustainability of road construction is critical to overall economy of the road transport sector. Several research projects are currently underway to study different construction methods, materials and designs that can improve the sustainability of roads.

The perpetual pavement concept is derived from a mechanistic principle that thickly designed hot mix asphalt pavements with the appropriate material combinations, if properly constructed, will structurally outlive traditional design lives while simultaneously sustaining high traffic volumes/loads. Perpetual pavement is designed and built to last 50 years or more without requiring major structural rehabilitation or reconstruction. With perpetual pavements, the potential for traditional fatigue cracking is reduced, and pavement distress is typically confined to the upper layer of the structure. Thus, when surface distress reaches a critical level, an economical solution is to remove and replace the top layer.

The Delhi-Mumbai Expressway is built according to perpetual pavement design along with other features such as wayside amenities and cargo facilities and access controlled lanes.[7]

Advanced technologies in tunnelling projects

At present in India, there are 1,489 tunnels covering 4,144 km in various stages – under implementation, awarded, under bidding, announced, approved, planned/proposed and stalled.

As per the data collected and analysed by India Infrastructure Publishing, a company providing information on the infrastructure sectors in India, for completed, ongoing and awarded projects, the drill and blast method (DBM) is the most common tunnelling method. It is used in over 38% of tunnel works. Deployment of advanced/mechanised technologies, such as tunnel boring machines (TBMs), is slowly increasing. At present, it has a share of 24%. This is closely followed by the new Austrian tunnelling method (NATM), which is increasingly being used across sectors.

With regard to technique/method of tunnelling, the road sector is moving towards adopting the advanced technology

[7] Article on Moneycontrol, March 8, 2019

of New Austrian Tunneling Method (NATM).

Highway operations and management

Technology-based initiatives are increasingly being adopted to improve operation and management of highways in India. Given below are the key among them.

Smart roads

'Smart roads' or 'smart highways' integrates technology with transportation infrastructure, including, but not limited to, functions such as generating power through solar panels, integration with self-driving cars and sensors and structural maintenance monitoring systems. Smart highways have the opportunity to turn from serving a singular purpose of being the backbone of a country's transportation system to providing additional value through generation of power, safety feature implementation and gathering of key data points for both road users and transportation administrators. Such data related to goods and people movement will have tremendous applicability.

Case study - Eastern Peripheral Expressway (EPE) - India's first smart and green highway

India's first smart and green highway, the 135 km Kundli-Ghaziabad-Palwal (KGP) Expressway also known as Eastern Peripheral Expressway (EPE), was inaugurated by Prime Minister Narendra Modi in 2018. The various components of EPE are:

Solar power plants: EPE is India's first highway to be lit by solar power. It has eight solar power plants, with capacity of 4,000 KW (4 MW) for lighting of underpasses and running solar pumps for watering plants.

Rainwater harvesting: It also has rainwater harvesting facilities on both sides in every 500 meters and there is a drip irrigation for plants all along the expressway.

Closed tolling system: It has a system that collects toll only for the distance travelled and not for the entire length. Toll plazas are equipped with ETC system for faster toll collection.

Weigh-in-motion (WIMs) equipment: They have been installed at all 30 entry points of the expressway to stop entry of over-loaded vehicles.

Auto challans: EPE has a system for auto challans that fines over-speeding as cameras along the highway captures speed of vehicles.

Intelligent traffic management: The EPE is equipped with smart and intelligent highway traffic management system (HTMS) and video incident detection system (VIDS).

Green cover: Over 2.5 lakh trees have been planted along the expressway, including transplant of 8-10-year-old trees. It has drip irrigation provision for these trees.

There have been many attempts around the world to create smart highways, with specific efforts focusing on solar roads and smart traffic infrastructure projects. However, many of these efforts have been met with mixed results, running into a variety of issues, most important being the cost efficiency of such interventions.

Intelligent transport management system (ITMS)

With the concept of smart city aimed at transforming cities into digital societies, ITMS becomes an indispensable component. Intelligent transport systems (ITS) aim to achieve efficiency by minimising traffic problems. It enriches users with prior information about traffic, local convenience, real-time running information, seat availability etc. which reduces travel time of commuters and enhances their safety and comfort.

Case Study - An IoT-driven transport management system for Ahmedabad[8]

The success story of Smart City Ahmedabad Development Ltd (SCADL) in transforming their manually operated bus transit system into a smart transportation system serves as

[8] NEC – Case Study - Smart City Ahmedabad gets IoT-driven buses

the best example of ITMS. SCADL partnered with NEC Technologies India Pvt. Ltd. to build a transportation system that suits a smart city. It helped the city to build an IoT-driven transport management system that had everything from software-based bus service system backed by advanced ICT to a cashless open-loop card system.

The ITMS incorporated five smart transport sub-systems:

Automated fare collection service (AFCS) - Quick and secure cashless payment via prepaid RuPay card or smartphone.

Automatic vehicle location system (AVLS) - Real-time visualisation of vehicle location via GPS.

Passenger information system (PIS) - Provide real-time bus information via mobile app, website and in-station boards.

Vehicle planning schedule and dispatch system (VPSD) - Bus routes and schedules optimised by analysis of bus travel performance and traffic volume.

Depot management system (DMS) - Allocate and optimise crew and overall bus operations by automating the management of vehicles, fuel, inventory, personnel, and vehicle maintenance.

ITMS helps decongest highways in a big way. Other associated benefits of the system are efficient transportation, increased safety, etc.

Advanced traffic management system (ATMS)

ATMS is a comprehensive platform of traffic management that covers monitoring, control and safety on highways. It employs a top-down management perspective that integrates equipment such as cameras and speed sensors, installed at various points along the road, with databases primarily to improve, ease, and organise the flow of traffic. The system gathers real-time data from those sensors and cameras, and relays it to a command centre for processing and analysis. The processed data helps provide many digital or physical services, including incident management, traffic routing, traffic-jam notifications, DMS messaging, etc.

The essential components of ATMS include:

Automatic traffic counter and classifier (ATCC) detects and records all categories of vehicles based on their length and number of axles and distance between the axles.

Command and control centre (CCR) facilitates the user to control the highway traffic system by providing real-time traffic data.

Emergency call boxes, as the name suggests, is used by the road user in distress to contact and inform the highway control center about any unfavourable situations.

Meteorological system or MET station is a facility with instruments and equipment to make observations of atmospheric conditions, including temperature, humidity, wind speed, wind direction.

Mobile radio communication system (MRCS) comprises the mobile radio base stations and handheld devices useful in verbal communications between in the concerned persons in the time of need.

Surveillance system by using closed circuit television (CCTV) cameras for highway surveillance. The video camera with pan, tilt and zoom feature will be mounted at a height so as to cover the target length of highway.

Variable message signs (VMS) are used to provide the requisite information to road users to improvise their safety and travel experience on the highway.

Recent development in ATMS in India[9]

An ATMS installation project was kicked off in Gurugram in March 2019. Under the project, select locations across 115 sectors of Gurugram and Manesar will have a variety of CCTV cameras to enforce traffic rules and do general surveillance.

The video surveillance system will help enforce traffic discipline through the use of AI-based analytics software such as automatic number plate recognition (ANPR) and red

[9] NEC – Newsroom article dated May 8, 2019

light violation detection (RLVD). The system will monitor traffic junctions and other sensitive areas to identify offenders and issue alarms. Subsequently, they will be issued e-challans (electronic fines).

In the first phase of the project, approximately 1,200 high definition (HD) and ultra-high definition (UHD) cameras are expected to be deployed in over 200 traffic junctions, sending video feeds to monitoring centers throughout the day.

Electronic toll collection (ETC) – FASTag

As part of the government's Digital India initiative, ETC through the implementation of FASTag is set to become mandatory from December 1, 2019, on all National Highways. The digital system has been developed by the National Payments Corporation of India (NPCI) and is based on the National Electronic Toll Collection (NETC) programme. It offers an interoperable nationwide toll payment solution, including clearing house services for settlement and dispute management.

FASTag is a device that employs radio frequency identification (RFID) technology for making toll payments directly while the vehicle is in motion. FASTag (RFID tag) is affixed on the windscreen of the vehicle and enables a customer to make the toll payments directly from the account which is linked to FASTag.

Till October 2019, ETC has been implemented throughout India with 450+ toll plazas across the country.[10] NHAI is currently working to convert all lanes into ETC enabled lanes.

Project monitoring information system (PMIS)

PMIS is a state-of-the-art, real-time project tracking and monitoring system deployed in MoRTH, NHAI, and NHIDCL. The system is currently being used by senior government officers and field offices across the country to conduct daily monitoring of over 3,000 projects across different stages of execution.[11]

PMIS has a comprehensive database with over 180 data fields being tracked for each project, and a further 500 fields specifically for complex PPP projects, covering all key progress matrices such as design progress, contracting progress, construction progress, land acquisition, compensation disbursement, toll and traffic information and concession / contract information.

[10] NPCI official website
[11] NHAI

Way forward

Technological innovations are transforming all sectors. The road sector is also seeing adoption and implementation of innovative technologies. Durable roads with long life and low maintenance are a priority now. In order to bear the increasing traffic load and to overcome various challenges, such as cost overruns and congestion, the sector will have to develop new materials, processes and technologies. This would require dedicated research and development by both the government and private sector. The key task, however, will be adoption and implementation of the new technologies and methodologies developed through R&D. Cost, bureaucratic interferences and sustainability are some of the major concerns that can potentially drive or obstruct the applicability of such technologies.

About FICCI

Established in 1927, FICCI is the largest and oldest apex business organization in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies. A non-government, not-for-profit organization, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policymakers and civil society, FICCI articulates the views and concerns of industry. The organization serves its members from the Indian private and public corporate sectors and multinational companies, drawing its strength from diverse regional chambers of commerce and industry across states, reaching out to more than 2,50,000 companies. FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policymakers, and the international business community.

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