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Integrated Digital Solutions for Highways Asset Management and Road Safety

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Speaker

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Sachin is an **Infrastructure Project Management professional** with more than 28 years of experience in PPP, EPC, LSTK infrastructure projects of Domestic & International market, dealing with Project Management, Contracts management, Project Life Cycle Management.

In his current role with **Vertis infrastructure Trust** (formerly Highway Infrastructure Trust), an Asset Management platform of managed by KKR and working as Vice President – Projects with responsibility of managing assets for operations and maintenance, bidding & acquisition of new infrastructure assets, Client, Investors', and stakeholders' coordination.

Integrated Digital Solutions for Highways Asset Management and Road Safety

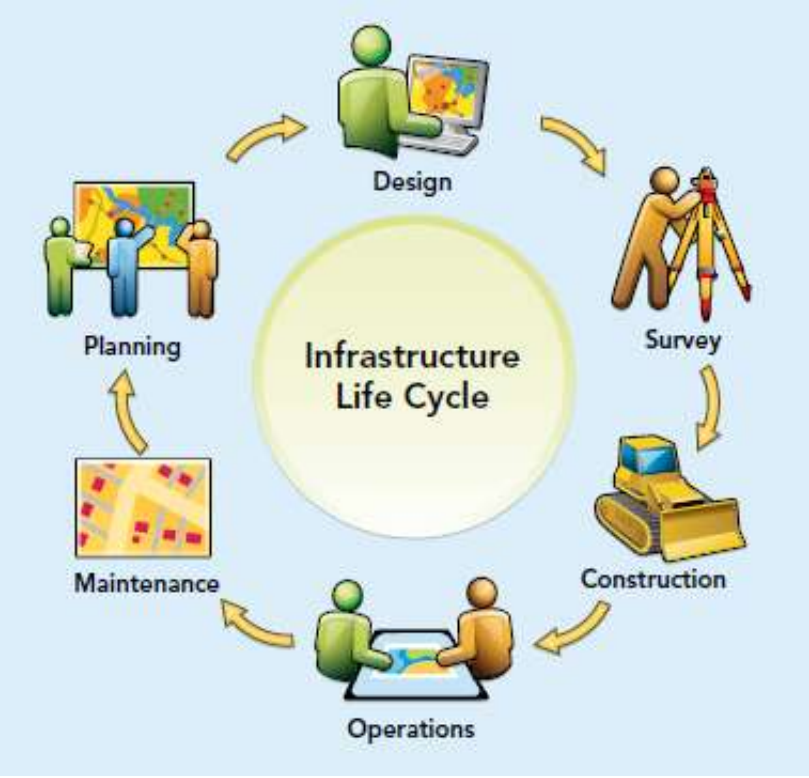
- Introduction
- Key Challenges in Highway Asset Management in India
- Road Safety Issues in India
- Integrated Solution: Integrated Digital Platforms
- Data Requirements of Asset Management life cycle
- Digital platform – Automatic Road Condition Analyser / NSV
- Typical Process flow dig in & Out of Road Condition Analyser
- Digital Solutions- LiDAR technology (Drone / Ground)
- Benefits of Integration of Digital Solutions

Introduction

- Highway Asset Management is the process of optimizing an asset lifecycle in most cost- effective, to optimize their service delivery potential and to reduce the related risks and costs.

- Challenges in maintaining road infrastructure and ensuring safety due to Aging infrastructure, increasing traffic, and safety concerns demand smarter solutions.

- Digital transformation with need for integrated, digital, and data-driven approaches offers a way forward through integrated systems.



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Key Challenges in Highway Asset Management in India

- **Aging Infrastructure**: Many national and state highways are aging and were not designed for current traffic volumes, leading to accelerated deterioration and higher maintenance demands.

- **Inadequate Funding and Budget Allocation**: Limited financial resources and inconsistent budget allocation hinder timely maintenance, leading to costlier repairs in the long run.

- **Lack of Accurate and Real-Time Data on asset condition**: There is often an absence of reliable, up-to-date data on asset condition, traffic patterns, and environmental impacts, which impairs effective decision-making.

- **Fragmented Institutional Responsibility across agencies/ Govt bodies**: Multiple agencies (central, state, and local) manage highway assets with varying standards and coordination, resulting in inefficiencies and duplication of efforts.

- Delays in Maintenance, reactive repairs impacting cost, longevity of assets and safety

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Road Safety Issues in India

- **High Accident and Fatality Rates**: India accounts for over 10% of global road crash fatalities, with thousands of lives lost annually due to traffic collisions.

- **Poor Road Design, Signage, Lighting and Maintenance**: Many roads have unsafe geometries, inadequate signage, lack of pedestrian infrastructure, and poor maintenance, increasing the risk of accidents.

- **Negligent Driving Behaviour**: Common issues include over-speeding, drunk driving, not wearing helmets or seatbelts, and reckless driving, especially among two-wheeler and commercial vehicle drivers.

- **Inadequate Law Enforcement of Traffic Rules and Emergency Response**: Weak enforcement of traffic rules and delayed medical response after accidents significantly worsen the impact of road crashes.

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Integrated Digital Solutions in Highway Asset Management

- **Automatic Road Condition Analyser (ARAN) / NSV**- for roughness index, rutting, pavement distress, ROW encroachments, etc.
- **LiDAR Technology**- (Mobile / Drone) Visual inspection and mapping of remote areas
- **Advance Traffic Management System (ATMS)** for traffic monitoring & Safety improvements-
  - Traffic Monitoring & Control Surveillance
  - VIDES (Vehicle Incident Detection & Enforcement system)
  - VASD (Vehicle Actuated speed display system)
  - VMS (Variable message signs)
  - ATCC (Automatic Traffic Counter and Classifier)
  - MET (Metrological Stations)
  - MRCS (Mobile Radio Communication System)
  - ERS (Emergency Response system)- SOS Call Booths
  - Incident Management System
  - Traffic Control Centres
- **IoT Sensors:** Real time monitoring of Pavement, bridge, weather, traffic flow

- **GIS Mapping:** Geospatially Spatial mapping of assets for inventory and maintenance

- **Digital twin** for Real-time digital representation of infrastructure for asset life cycle management.

- **AI & Analytics for accident black spots, Mobile applications & Dashboards:** Predictive maintenance and Field assessment & visualization

- Integration of Geographic Information Systems (GIS), IoT, AI/ML, and BIM
- Interoperability across departments and systems.

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Asset management cycle requirements

Physical Asset Type	Data requirements
Asset Inventory	As built inventory, design- drawings, condition assessment, performance parameters
Pavement	As built inventory, design- drawings, construction history, maintenance history, Structural adequacy, distresses, serviceability, roughness, deflection & remaining design life & other performance parameters,
Bridges & Structures	
Road Signages	As built inventory, design- drawings, condition assessment, reflectivity, installation, and maintenance history
Highway Lightings, Electronic signals	As built inventory, design- drawings, condition assessment, installation and maintenance history, efficacy, energy usage, environmental impact
Pavement markings/ delineators	As built inventory, design- drawings, condition assessment, efficacy, reflectivity, maintenance history
Drainage	As built inventory, design- drawings, condition assessment, efficacy, environmental impact, maintenance history
Toll Management & Operations	As built inventory, design- drawings, TMS performance, traffic data analysis, performance analysis of TMS system, energy usage, maintenance history
Advance Traffic Management System	As built inventory, design- drawings, system efficacy, performance analysis, safety black spot analysis, traffic congestions, weather reports, incident operations, maintenance history
Surveillance and Incident Management	As built inventory, accident data reporting & analysis, fleet operation analysis, fuel & maintenance history, efficacy of system
Public facilities & amenities	As built inventory and drawings, housekeeping and maintenance history, customer requirement and facility management

Automatic Road condition Analyser / NSV

> TEXTURE (Option 2)
The LCMS sensors calculate full lane width texture measured in 5 AASHTO brands

> POSITIONING – POS LV 220
The POS LV tracks the position and orientation of the ARAN in real-time. This position and orientation solution and combines data from tactical-grade fiber optic gyros and accelerometers, a differential GPS, and a DMI.

> POSITIONING - GPS
Every ARAN is equipped with a GPS and is integrated with other subsystems so that if the receiver cannot lock on enough satellites to determine its position, the ARAN DMI and the ARAN Inertial Reference System will fill in the gaps.

> PAVE3D DISTRESS
With the ARAN's LCMS subsytem, 3D profile data is used for automated detection and full lane width image display.

> RIGHT-OF-WAY VIDEO
The ARAN can be outfitted with as many as six HDTV cameras which captures right-of-way images allowing you to virtually view the road from the comfort and safety of your office.

> PAVE3D RUTTING
The 3D Laser Measurement System uses dual scanning lasers to accurately measure the transverse profile of the road with 4000 points over 4 meters.

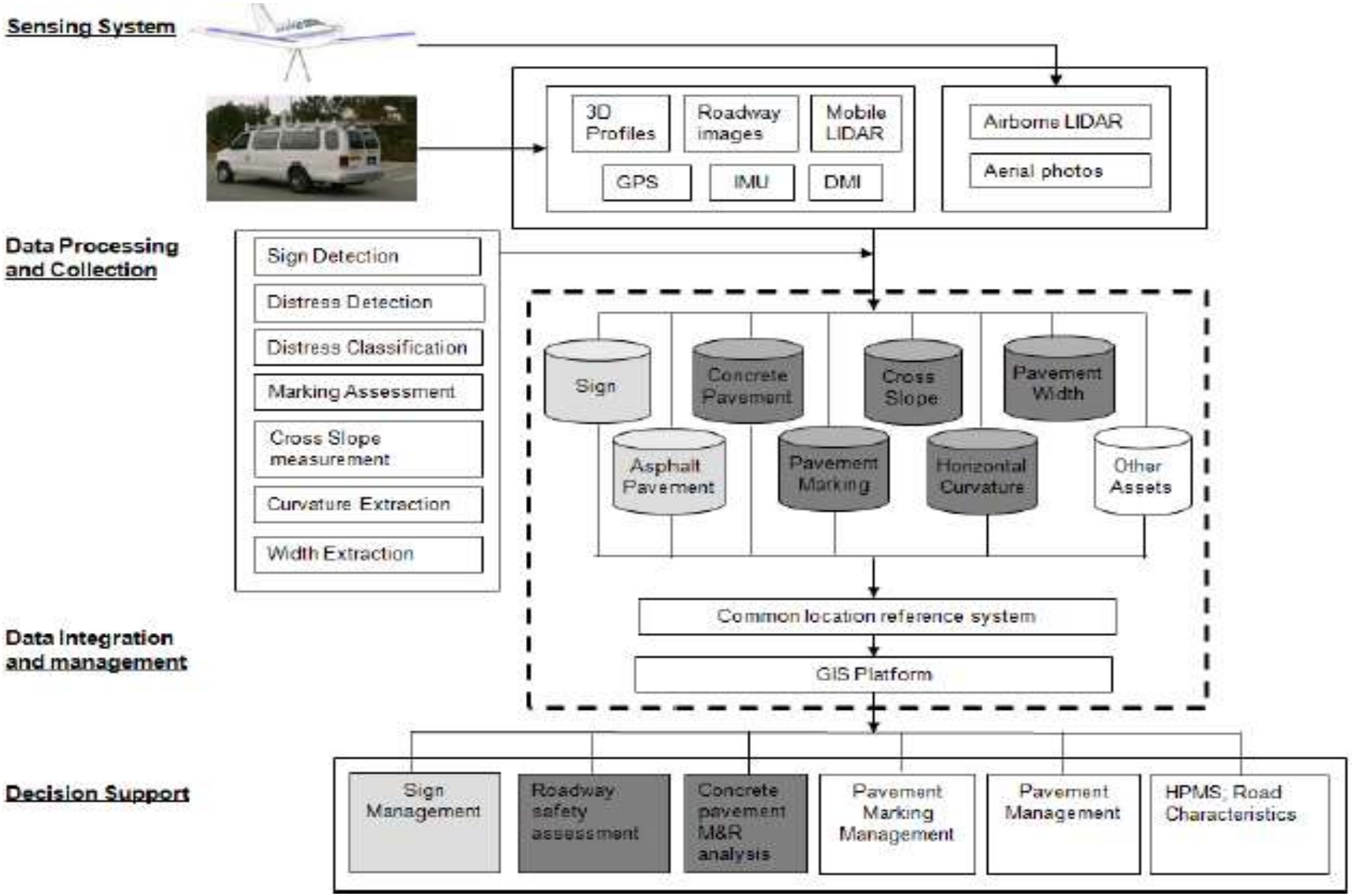
> GROUND PENETRATING RADAR
An electromagnetic device used to detect changes in road structure, including material thickness, changes in material and changes in material condition.

> ROUGHNESS
The Laser SDP is a longitudinal profile measurement system that provides road profile data capture and real-time roughness index calculation using a combination of high-speed lasers and accelerometers.

>TEXTURE (Option 1)
Smart Texture utilizes high frequency lasers to measure the mean profile depth of road surface macrotexture.

> POSITIONING - DMI
The Distance Measuring Instrument measures ARAN chainage and linear distance travelled. Every ARAN is equipped with a GPS and is integrated with other subsystems so that if the receiver cannot lock on enough satellites to determine its position, the ARAN DMI and the ARAN Inertial Reference System will fill in the gaps.

Typical Data flow of Asset Management system



Geospatial technology solutions in Asset Management

Some of the most common geospatial technologies include:

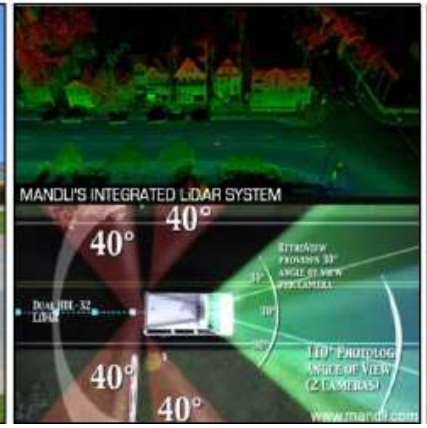
1. **Remote Sensing (RS)-** This technology used to study objects or surfaces at faraway distances using the images and data collected from space or airborne camera and sensor platforms. Experts can assess the assets properties and make conclusions by measuring and analysing the data collected by the sensor platforms. This includes-

    1. Digital aerial images from airplanes and advance aerial drones survey and inspections,
    2. LiDAR technology- Aerial LiDAR & Mobile mounted LiDAR

2. **Geographic Information System (GIS)**

3. **Global Positioning System (GPS):** It is a navigation system using satellites, a receiver, and algorithms to synchronize location, velocity and time data for Air, Sea and Land travel.

Terrestrial LiDAR system



Mobile LiDAR system

Aerial LiDAR system

Aerial Drone LiDAR system

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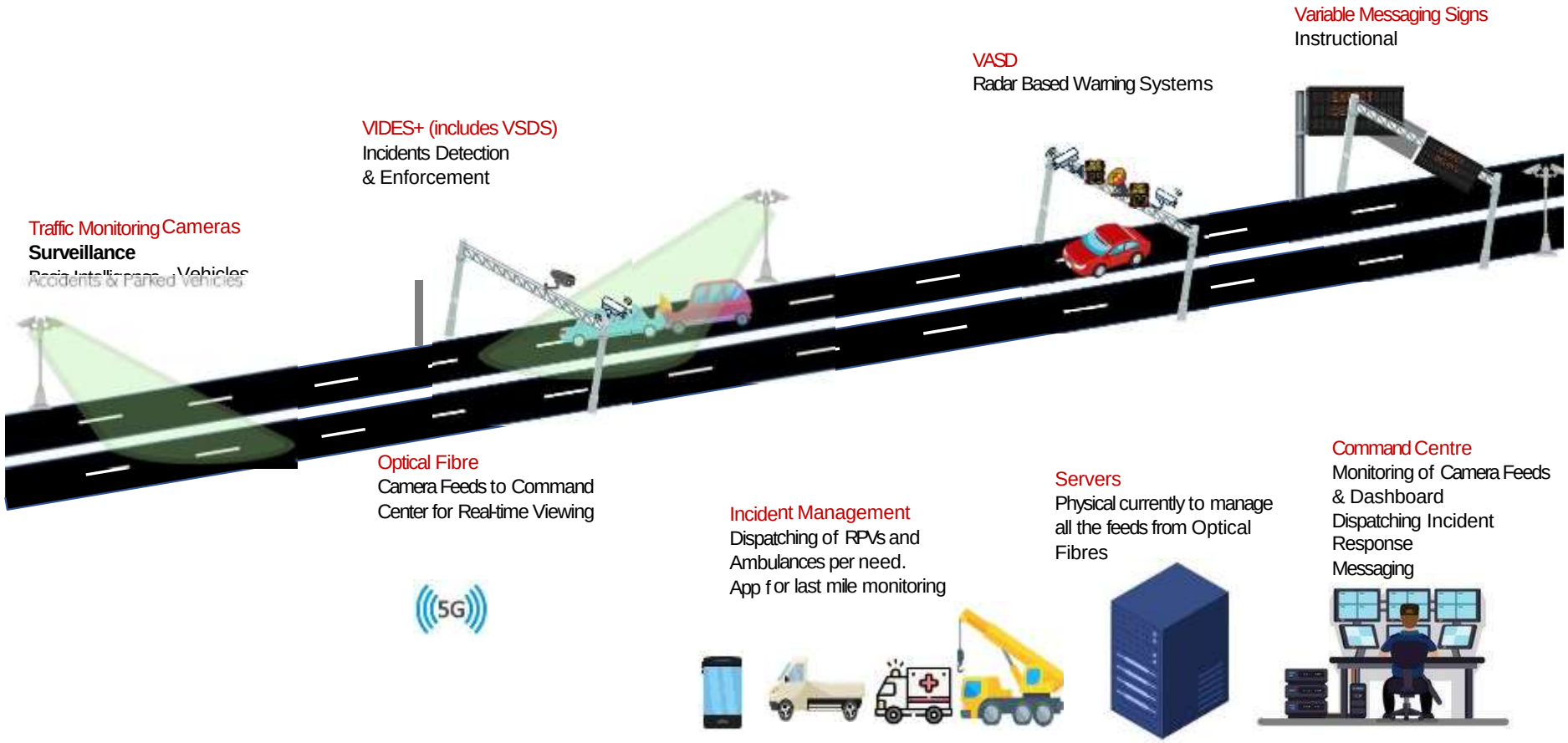
Advance Traffic Management System (ATMS)



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Benefits of Integration of Digital solutions

- **Improved Efficiency by Real-time monitoring and decision-making:** for planning, execution, monitoring, timely completion of projects with detailed data analysis using digital maps, topography, traffic, etc.
- **Inventory management & condition assessment:** it reduces response time to incidents and infrastructure failures by use of digital solution likes drones, mobile GIS
- **Cost effective maintenance planning**:- Proactive highway maintenance, optimum utilization of resources, Lower long-term maintenance costs and Improved asset longevity efficient asset lifecycle management
- **Enhanced Safety :** with data driven analysis safety improvements and reduce accident.
- **Enhanced transparency and compliance**- Better coordination among stakeholders will help increase public & other stake-holders participation.

Thank You !

“Integrated Digital Solutions creates smarter, safer, and more sustainable highways for the future”.