Capability Profile

June 2021

V R TECHNICHE Consultants Pvt Ltd

Strictly Confidential

Outline

- Genesis and Development of V R TECHNICHE
- Key Differentiators
- Fields we Work
- Spread of Assignments
- Clientele
- Key Highlights of Services
- Contributions of V R TECHNICHE to Consulting
- Team Members
- International Projects

Genesis of V R TECHNICHE

- Established in May-2007, with a focused vision of providing quality services in the field of Travel Demand Estimation and Engineering Designs with following objectives:
  - ✓ To provide professionally committed consulting services
  - ✓ To provide platform for budding professionals to enhance traditional practices of Indian Consulting Industry
  - ✓ Identification and Utilization of Technical Tools, Analytical methods and processes
  - ✓ Set up practice oriented R&D works for betterment of Industry

- Currently operates from two offices – Noida and Hyderabad

- V R TECHNICHE, owing to its unique expertise and quality of services, has been preferred consultant for various stakeholders including Institutional Investors, Lenders and Developers etc.

Development of V R TECHNICHE

- With same genesis, over the past decade, V R TECHNICHE augmented expertise in technical services at planning, designing, construction and O&M stages of various infrastructure projects

- Currently, V R TECHNICHE is one of the market leaders in -
  - ✓ Travel Demand Estimation for Highways
  - ✓ Technical Evaluation, Maintenance Strategy for Highways, Pavements and Structures
  - ✓ Technical Due Diligence of Highway Assets
  - ✓ Lenders Advisory Services for Infrastructure Projects
  - ✓ Engineering Designs
  - ✓ Audit of Highway Structures

- Along with Technical Expertise, V R TECHNICHE has strong experience in Highway Project Operation Strategy such as – *Routine Maintenance, Major Maintenance, Safety Management during Operations and Maintenance activities, etc.*

- Has been involved in setting up Asset Management frameworks for Investors and Lenders

Key Differentiators

- Keeping genesis intact, established *inclusive working environment* for Young professionals to practice their learnings and ideas

- One of the first consultants to implement the following in India:
  - ✓ Use of Video Based Counting for Highway Projects
  - ✓ Development of ATCC for Indian Traffic Conditions: *Brain behind ATCC tool developed by BHARI Infra Pvt Ltd*
  - ✓ Use of Network Survey Vehicle, FWD for Pavement Evaluation in Engineering Design and Technical Due Diligence
  - ✓ Use of Mobile LIDAR and Latest Technology for Engineering Designs
  - ✓ Active participation in R&D which are useful for Industry, such as – All India Network Assignment Model, Analyzing Vehicular Composition Change, Material Investigations, Quality Control practices, road safety concerns, O&M Strategy
  - ✓ Use of New Technology for Pavement Materials in India
  - ✓ Use of Technology based Road Safety Investigations; Road Safety SOPs at O&M Stages
  - ✓ Use of Drones for visual condition inspection of Structures

- *R&D on various technologies and industry issues is ongoing and likely to add many more above list in near future*

Vectors we work

We provide Comprehensive NICHE Consulting Services in Transportation Sector which includes:

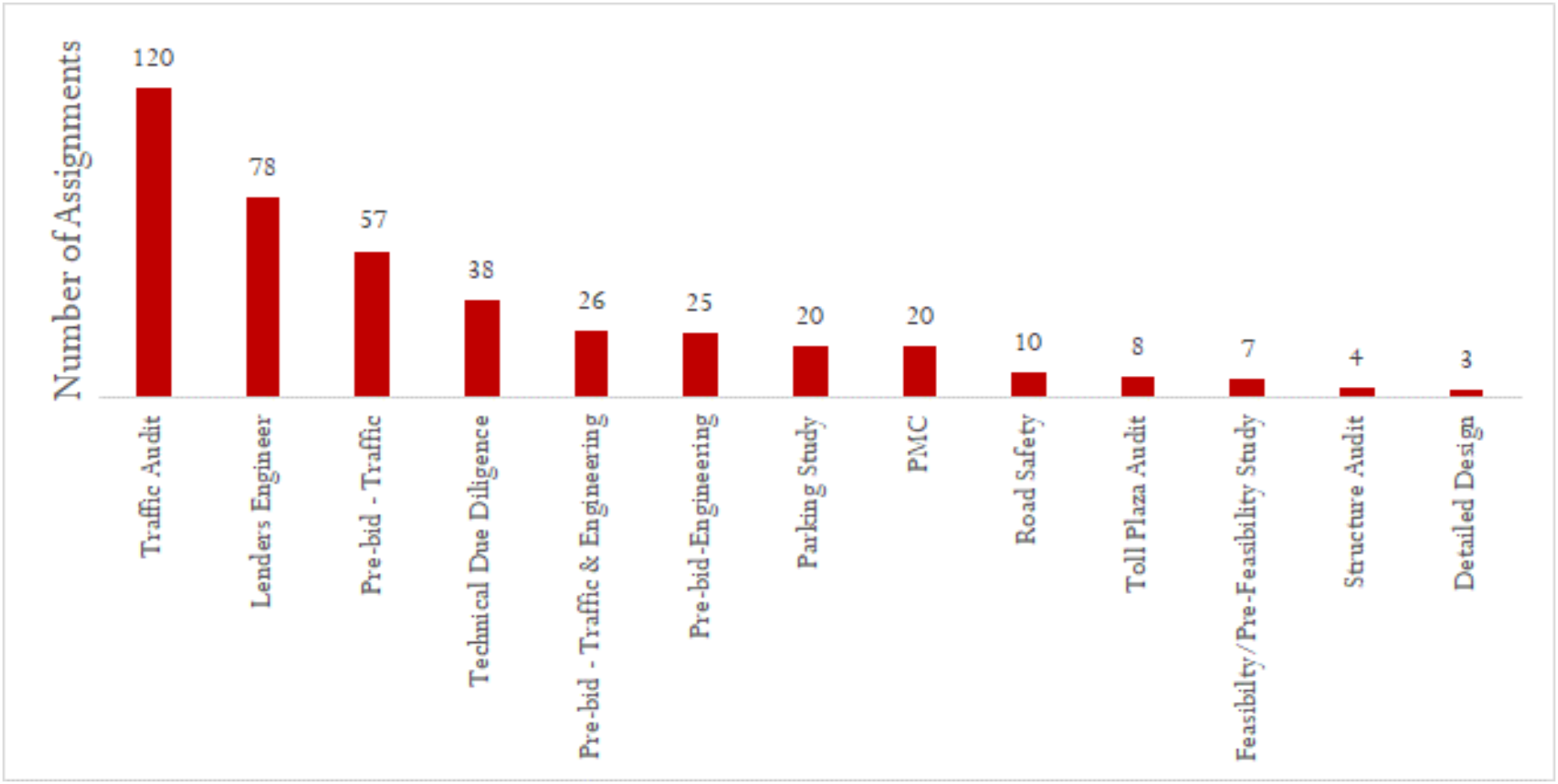
- Travel Demand Estimation
- Traffic and Transportation Planning
- Evaluation and Design of Highways, Pavements & Structures
- Operation and Maintenance Strategy
- Project Management Consulting
- Inspection of Highway Structures
- Lenders Advisory Services
- Road Safety
- Asset Management Frameworks
- Intelligent Transportation Systems

Spread of Assignments in India

Map Updated on January-2018

- ✓ Technical Consultant to NHAI for TOT Bundle-1 (676 km)
- ✓ 400+ Traffic & 150+ Technical DDs for Institutional Investors and other stakeholders
- ✓ Collection of Traffic Data using ATCC for IHMCL at 300+ locations for 5 years
- ✓ 50+ APC studies for NHAI
- ✓ Appointed as LIE in 100+ Assignments till date
- ✓ TMS Audit for 60+ toll plazas
- ✓ Road Safety Inspection for 1500+ km of NH/SH
- ✓ Successfully executed Consultancy Assignments in Indonesia, Kenya, Bhutan, Tanzania, Gabon and Ghana *(Ongoing)*.

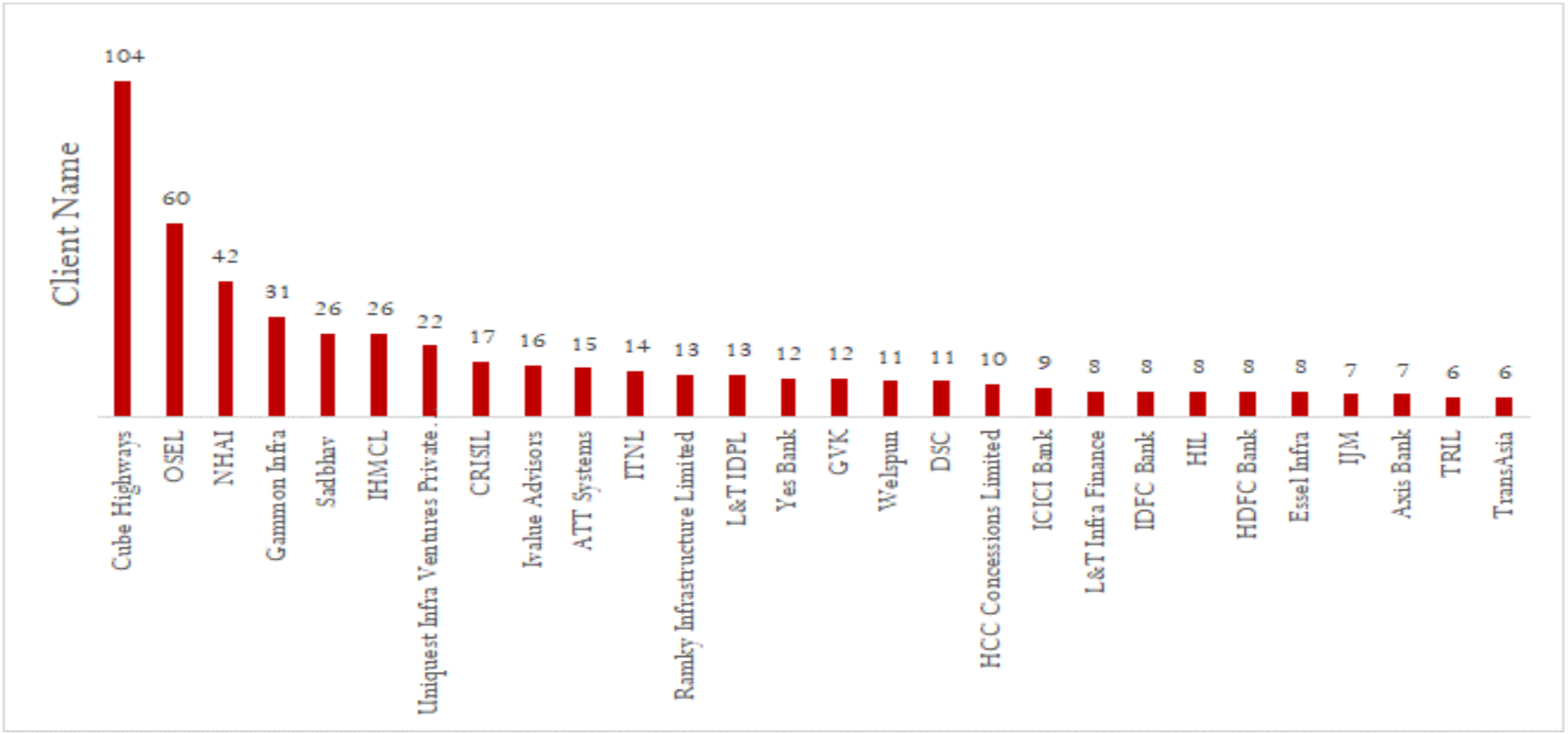
Numbers of Assignments



Additionally, V R TECHNICHE has conducted traffic audit using Automatic Traffic Counter and Classifier (ATCC) at more than 2000 locations for Indian Highways Management Company Limited (IHMCL), National Highway Authority of India (NHAI) etc.

Clientele

Over a period of 14 years, V R TECHNICHE has established a huge client base – particularly Private Developers, Banks and Investors.



V R TECHNICHE has worked multiple times for same clients

Key Highlights of Services

- **Travel Demand Estimation**
- Traffic and Transportation Planning
- Evaluation and Design of Highways, Pavements & Structures
- Operation and Maintenance Strategy
- Project Management Consulting
- Lenders Advisory Services
- Road Safety
- Asset Management Frameworks
- Intelligent Transportation Systems

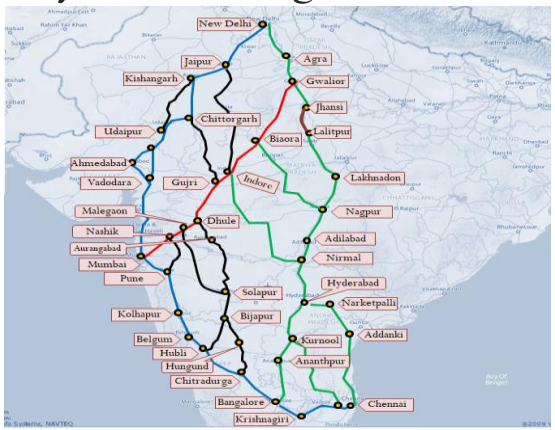
Travel Demand Estimation

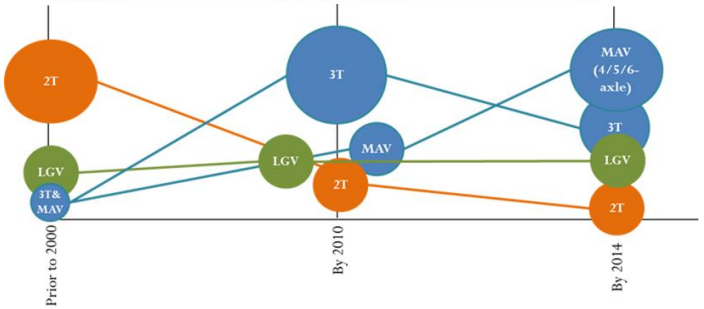
- **Objective:** To act as NICHE player in the area of Travel Demand Estimation for providing auditable base numbers and reliable forecasts based on analytical rigor.
- **Scope of Services:** V R TECHNICHE provides services for travel demand estimation for following transportation facilities at various stages of the project (during Pre-bid, Post-bid, Financial Closure, Investment, Refinancing etc.)
  - ✓ Toll Roads
  - ✓ Metro Corridors
  - ✓ Bus Transit
  - ✓ Personalized Transit Systems (PRT)
  - ✓ Rail Corridors
  - ✓ Fully-automatic / Semi-automatic / Manual Parking Systems

The data base along with extensive experience has helped V R TECHNICHE to develop numbers of forecasting tools which model travel behavior of Indian driver in more reliable manner

Travel Demand Estimation – *Key Highlights*

- V R TECHNICHE has worked on travel demand and revenue estimation for more than 400 projects covering almost all major Trunk routes across India
- Strong understanding of Travel Characteristics across Indian Highway Network
- Ability to understand changing travel patterns along with changing mode choice
- Multiple studies for same projects at various stages has been key to Learnings and Enhancement at V R TECHNICHE
- Has been key impact player in Travel Demand Estimation by means of
  - ✓ Elimination of Manual Counting and Introduction Auditable Video / ATCC based technologies
  - ✓ Reliable methods for estimation toll traffic discounts
  - ✓ Identification & Quantification of Risks and Upsides for toll roads
- Proven track record of estimating changing Travel Pattern on number of Projects across the country





Travel Demand Estimation – *Key Highlights*

- V R TECHNICHE in association with BHARI Infra Pvt Ltd (*our group company*) has developed two methods for accurate counting and classification of traffic
  1. Video based count and classification (with Manual Intervention)
  2. Portable, non-intrusive and automatic traffic counter cum classifier (ATCC)
- ATCC systems developed in house are used for Traffic Counting at more than 2000 weekly counts

Video

Snapshot of Video Output



Video Camera Setup



ATCC Setup

Systems provide more than 98% accuracy for Counting and Classification for medium density of Traffic at mid-block locations. Further development for ATCC is underway for various other traffic conditions

Key Highlights of Services

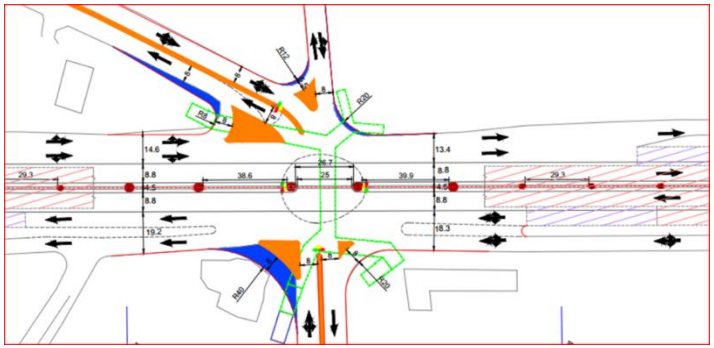
- Travel Demand Estimation
- **Traffic and Transportation Planning**
- Evaluation and Design of Highways, Pavements & Structures
- Operation and Maintenance Strategy
- Project Management Consulting
- Lenders Advisory Services
- Road Safety
- Asset Management Frameworks
- Intelligent Transportation Systems

Traffic and Transportation Planning

- **Objective:** To provide NICHE services in following sectors of traffic and transportation planning sector -
  - ✓ Traffic Impact Assessment
  - ✓ Parking System Design –Manual / Semi-automatic / Fully-automatic
  - ✓ Bus Terminal Design
  - ✓ Personalized Transit System Design
  - ✓ Traffic Management Solutions
  - ✓ Traffic Circulation Plans
  - ✓ Design and Improvement of Intersections, Signal Designing
  - ✓ Development of Comprehensive Corridor Improvement Plan
- **Scope of Services:**
  - ✓ Provide various consulting services at various stages of Project like Planning, Bid Process Management, Post construction Audit etc.

Traffic and Transportation Planning – Key Highlights

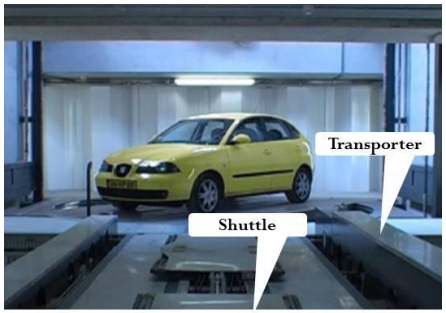
- **Worked on Selective but Challenging Projects** related to Traffic Circulation, Traffic Impact Assessment, Fully Automated MLCP etc.
  - ✓ Traffic Counts at 7-entry major points of Delhi and Broad estimation of through traffic entering Delhi (for EPCA)
    - ➢ *This study was part EPCA's Report based on which Hon. Supreme Court of India (mentioning the said study) implemented Environmental Compensation Charge on goods vehicles as Pollution Control Measure for Delhi*
  - ✓ Traffic Study and Improvement Strategy on Pimpalgaon-Nashik-Gonde (PNG) Section of NH3 at Indira Nagar and Dwarka Junction
  - ✓ Traffic Study for identifying possible Entry and Exit Points for proposed Advant Solaris Business Park (Plot No.-1) in Sector 142, NOIDA
  - ✓ Traffic Circulation Study for Advant Navis Business Park
  - ✓ 1500 ECS Fully Automated MLCP for Delhi High Court

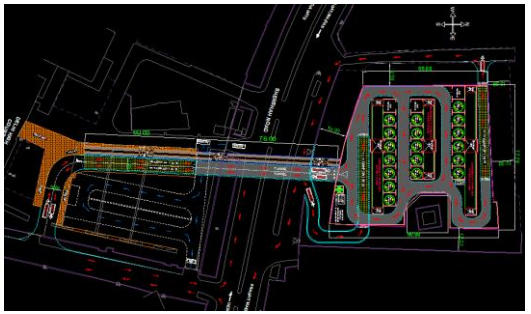


Traffic and Transportation Planning – Case Study

- Preparation of feasibility study and evaluation of technical bid for Delhi Metro Rail Corporation Ltd (DMRC) on multi-level fully automatic parking complex for Delhi High Court with provision to park 1500 cars and SUVs.
- One of the largest Fully Automated MLCPs in India

- Worked on various parking projects (both Automatic and Manual Parking) and gained expertise in conceptualization of automatic MLCP consisting of following tasks –
  - ✓ Parking Demand Analysis
  - ✓ Choice of Parking System
  - ✓ Development of Concept Plan
  - ✓ Parking Project Structuring
  - ✓ Simulation of Parking System
  - ✓ Traffic Impact Assessment
  - ✓ Vehicle Accessibility Plan and Traffic Circulation Plan



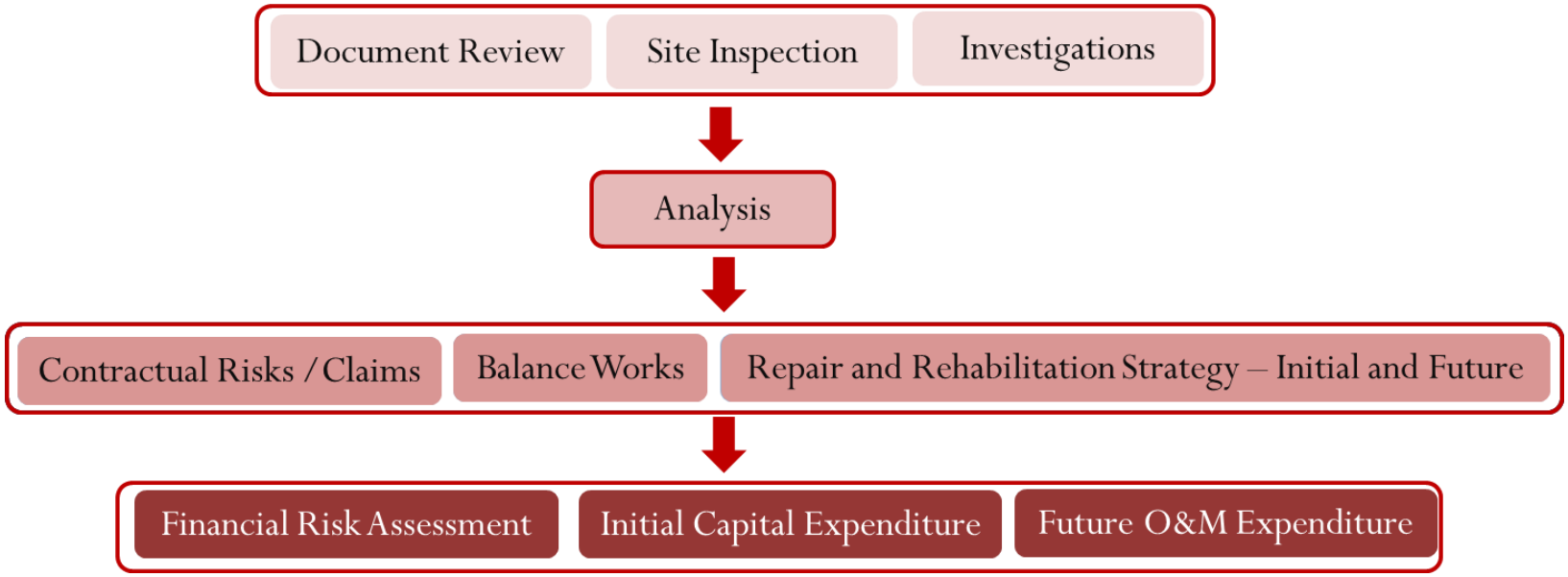


Key Highlights of Services

- Travel Demand Estimation
- Traffic and Transportation Planning
- **Evaluation and Design of Highways, Pavements & Structures**
- Operation and Maintenance Strategy
- Project Management Consulting
- Lenders Advisory Services
- Road Safety
- Asset Management Frameworks
- Intelligent Transportation Systems

Evaluation and Design of Highways, Pavements & Structures

- **Objective :**
  - ✓ Assessment of the physical condition including contractual issues to assist investors/bidders with proper evaluation of Highway Assets
  - ✓ To provide the economical and cost-effective Engineering Designs for the highway sectors
  - ✓ To safeguard the interests of the investor by providing the required insight into current condition, obligations and future requirements through techno-commercial skills
- **Process Flow:**



Evaluation and Design of Highways, Pavements & Structures - Services

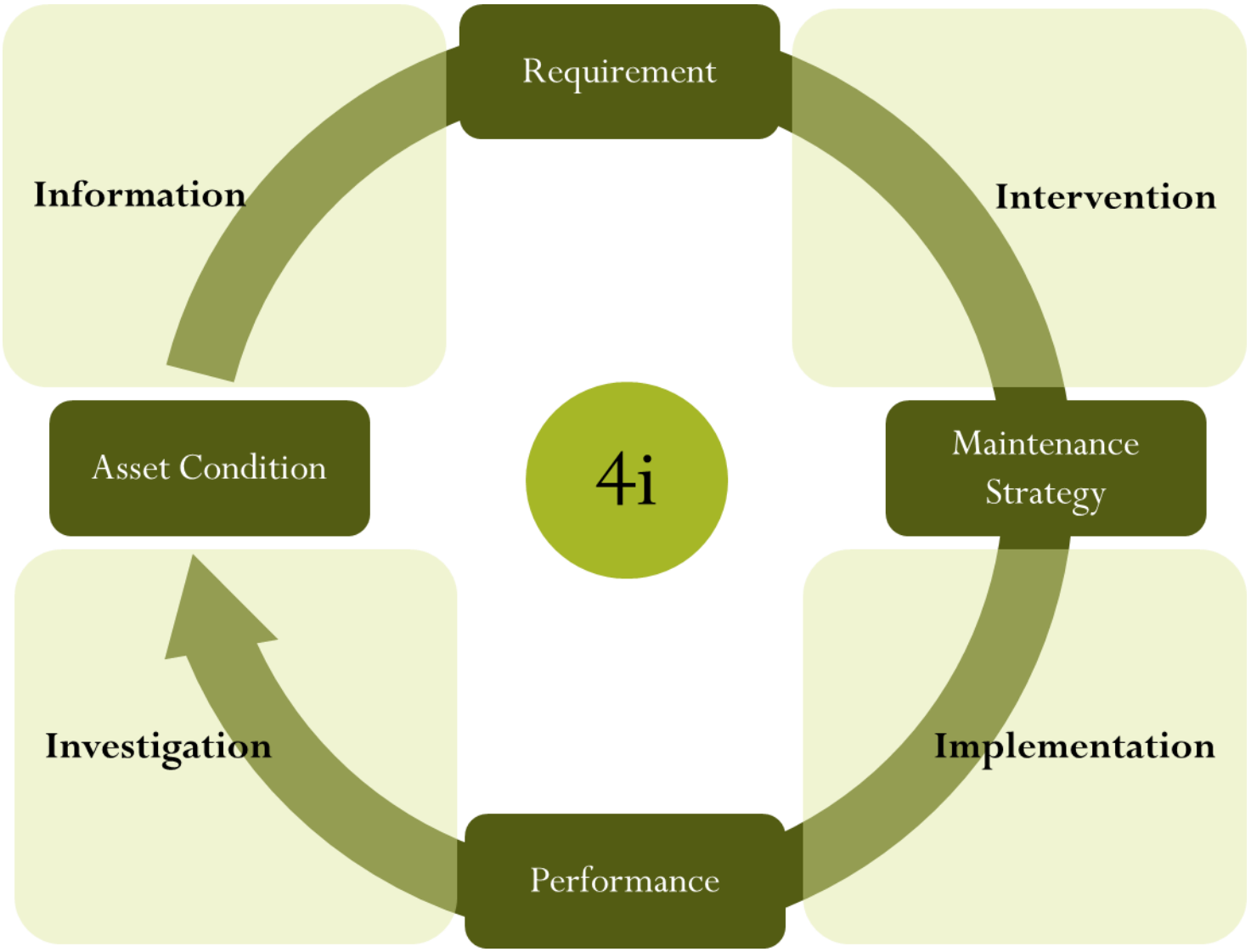
Document Review	✓ Review of Project Documents - Concession Agreement, EPC Agreement, MPR, LIE and IE Reports ✓ Review of Project Correspondences and Identification of critical issues related to non-compliance of CA provisions, Claims, Penalties, Punch List Items and other Balance Works etc.
Site Inspection and Investigations	✓ Inventory Survey ✓ Condition Survey of Structures – Manual and Drone Videography ✓ Non- Destructive Testing of Structures ✓ Axle Load Survey, Investigation of Pavement Distresses : Extent, Cause. ✓ Pavement Composition of the Carriageway ✓ Structural Strength and Functional Properties of the pavement ✓ Material Characterization of Pavement Materials, Structural Materials. ✓ Road Safety Audit ✓ Toll Plaza Systems and HTMS Audit
Analysis	✓ Deviation of Actual Construction Works as compared to CA provisions ✓ Condition Evaluation of Structures and Maintenance Needs ✓ Condition Evaluation, Remaining Life of Pavement and Maintenance Requirements ✓ Condition Evaluation of TMS and HTMS Systems and Maintenance Requirements ✓ Accident Analysis and Identification of Safety Improvement Requirement ✓ Identification of Non Compliance of O&M Activities ✓ Evaluation of Current O&M Expenses for the Project based on Project Financials ✓ Identification of Claims and Penalties

Evaluation and Design of Highways, Pavements & Structures - Services

Cost Estimation

- ✓ Determination of Initial Maintenance Cost for all assets in the Project
- ✓ Maintenance Strategy for Pavement for Future
- ✓ Estimation of Operating, Routine Maintenance and Periodic Maintenance Expenses for the Project
- ✓ Estimation of Balance Quantities and Cost
- ✓ Estimation of Cost of Punch List Items
- ✓ Estimation of Upgradation Cost
- ✓ Evaluation of Claims and Penalties based on Project Correspondences

Pavement Maintenance – Sustainable Approach Cycle



Asset Information- Pavement Investigations

Parameters	Investigation
Traffic Volume and Growth Rates	▪ Toll Traffic Data ▪ Independent Traffic Counts using ATCC and Videography ▪ OD Surveys
Vehicle Damage Factor (VDF)	▪ Axle Load Survey
Functional Condition Evaluation	▪ Condition Survey using Network Survey Vehicle (NSV)- Roughness, Rutting, Pavement Distresses,
Structural Condition Evaluation	▪ Falling Weight Deflectometer (FWD) Survey- Remaining Life Analysis
Subgrade and Pavement Layer Properties	▪ Test Pits – Determination of Soil and Granular Layer Properties ▪ Core Cutting – Bituminous Layer Properties
Distress Propagation	▪ Core Cutting

Asset Information- Travel and Loading Pattern

Understanding of **Travel Pattern** on a multilane divided carriageway gives a general sense behind any observed distress in any particular lane

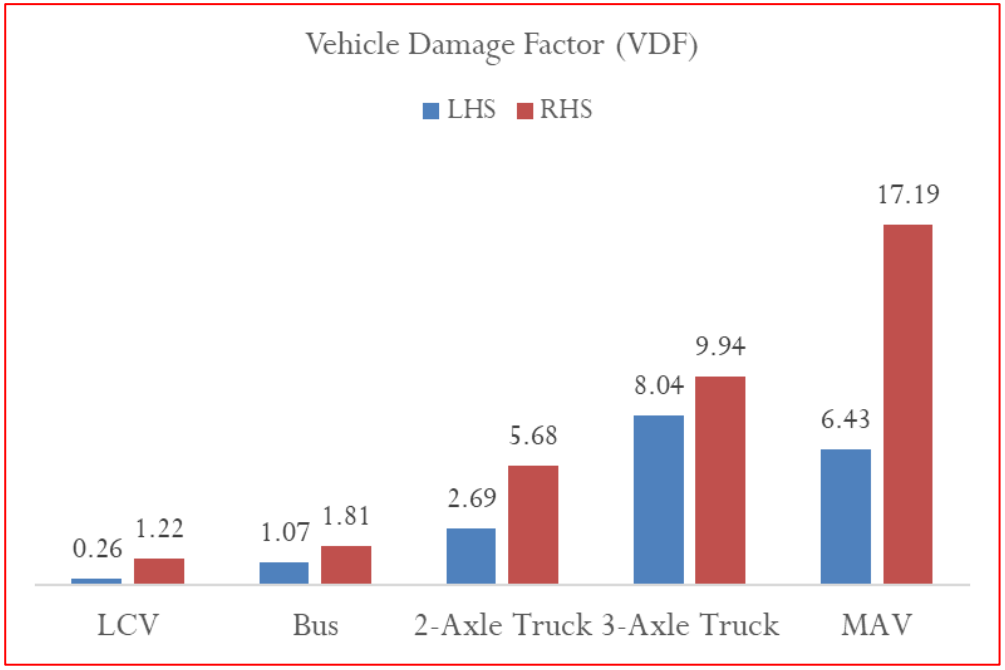
As can be observed from the pictures above heavy commercial vehicles are forced to move in the inner lane as there are impedances in terms of slow moving in the outer lane. Owing to the lane choice behavior the inner lane will be subjected to more loading and prone to accelerated deterioration.

Understanding of **Loading Pattern** on a multilane divided carriageway gives a general sense behind any observed distress in any particular direction

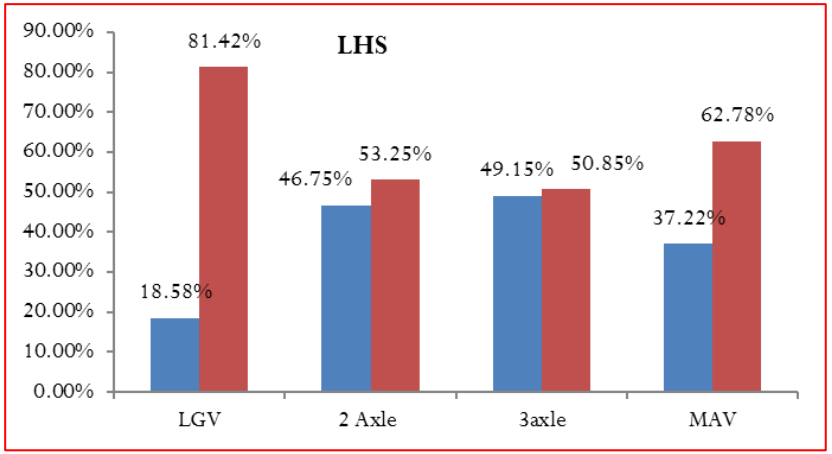
As can be observed from the pictures above of empty trucks observed in direction1 as while loaded trucks in direction 2 due to commodity movement pattern. Owing to the load carrying pattern, direction 2 will be subjected to more loading and prone to accelerated deterioration.

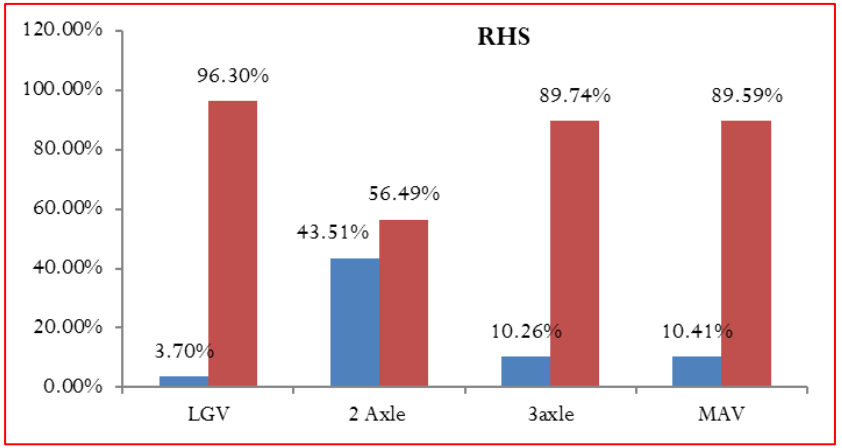
Asset Information- Vehicle Damage Factor

Vehicle Damage Factor

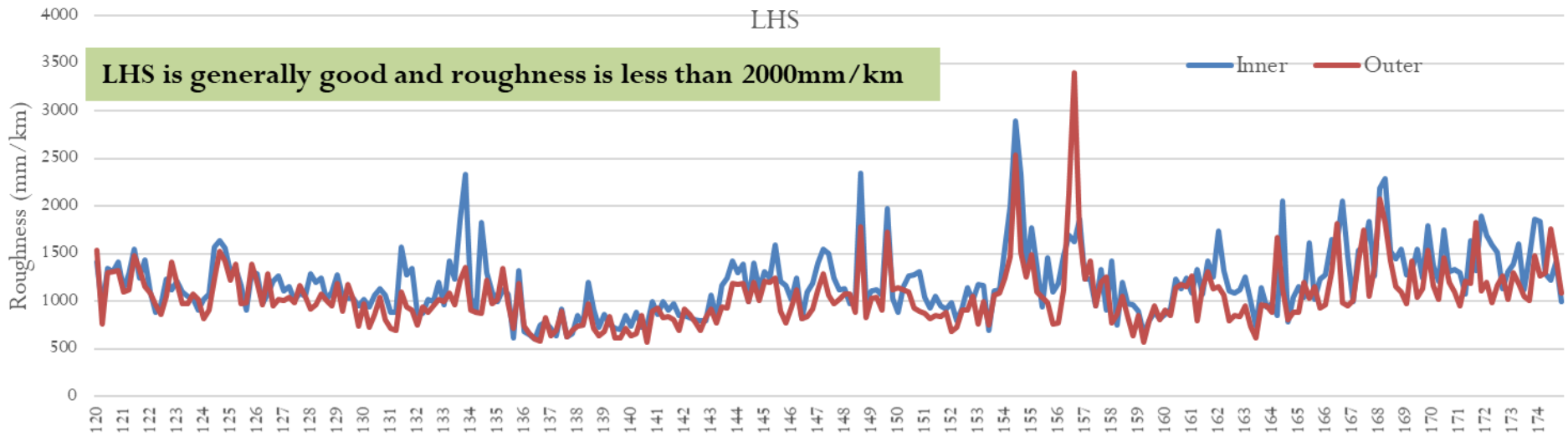


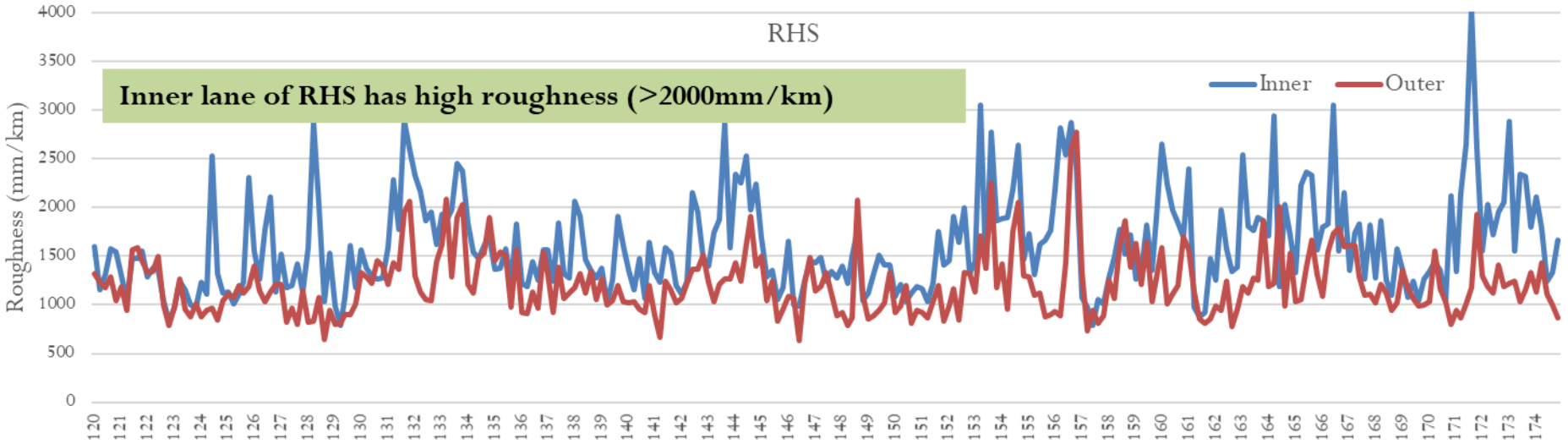
Loading Pattern



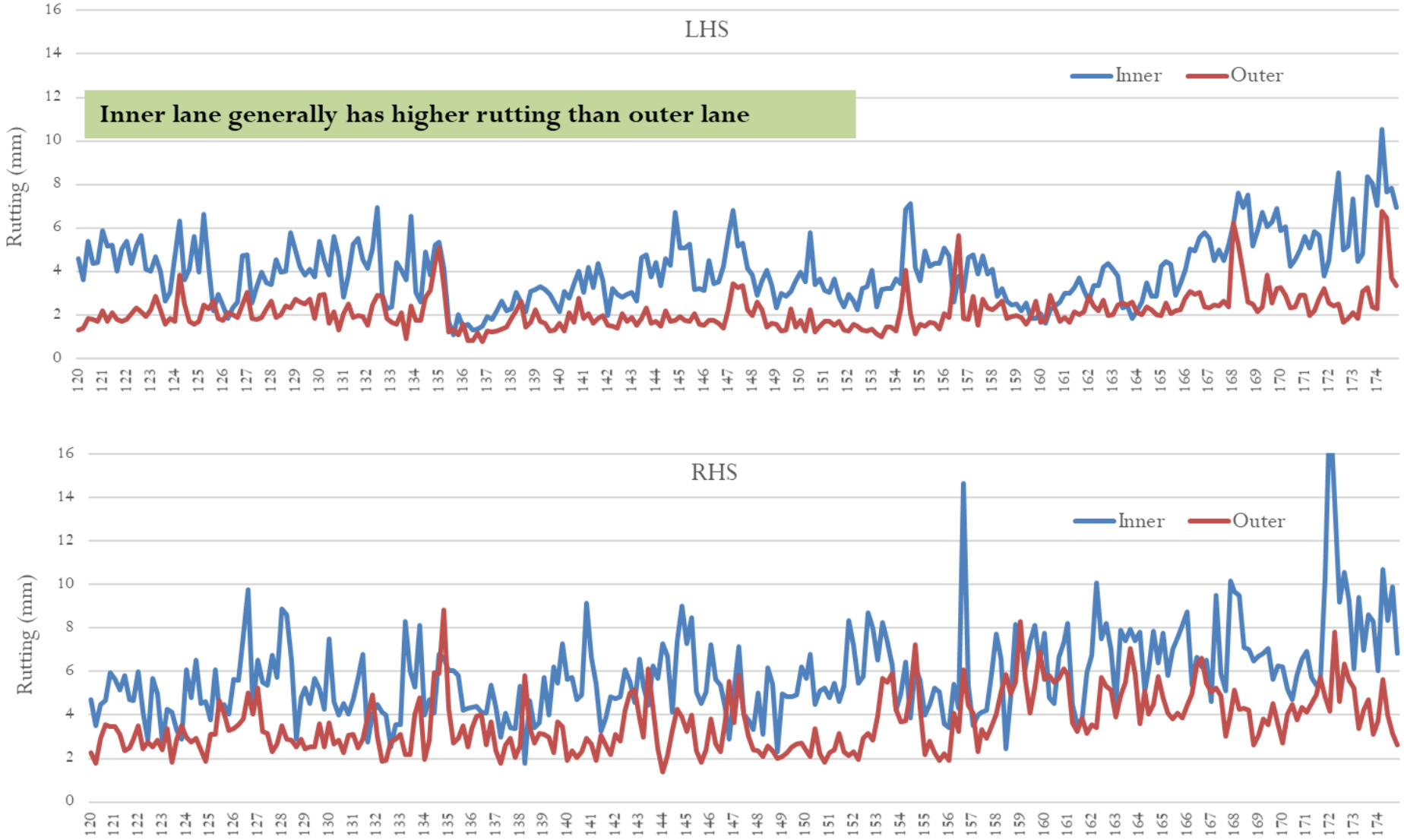


Asset Information- Functional Parameters

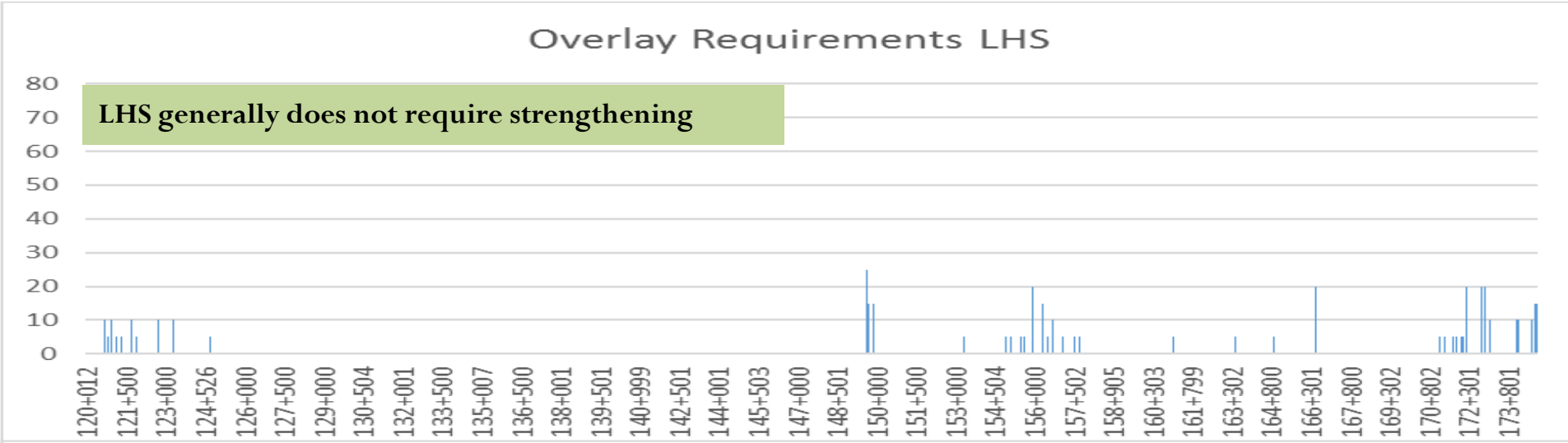




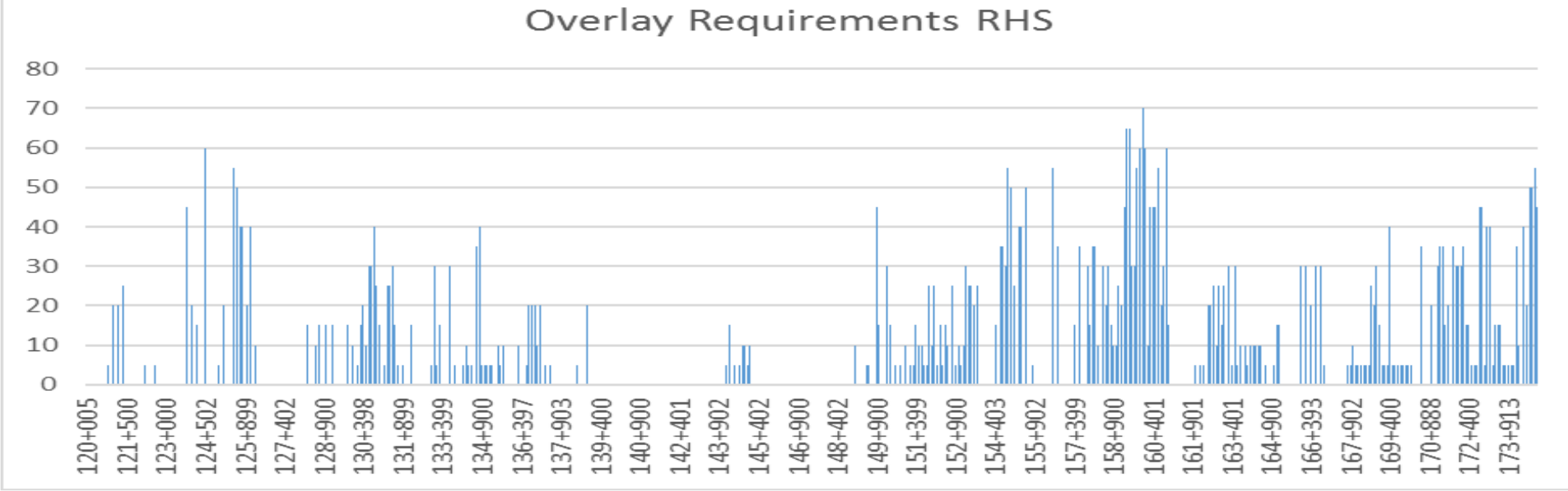
Asset Information- Functional Parameters



Asset Information- Structural Parameters



LHS generally does not require strengthening



Maintenance Strategy

Parameter	Condition of Pavement LHS	Condition of Pavement RHS	Major Maintenance strategy LHS	Major Maintenance strategy RHS
Axle Load	Moderate	Very High	1. Microsurfacing/ Overlay. 2. Polymer Modified Emulsion to be used for Microsurfacing	1. A high modulus rut resistant mix is to be provided to resist heavy loads. Stone Matrix Asphalt , is highly rut resistant mix which resists permanent deformation hence, have longer life. 2. Traditional BC will be used in sections having moderate loads and distress. 3. Polymer Modified Bitumen/Highly Modified Bitumen to be used for BC and SMA.
VDF and Traffic Load	Moderate	Very High		
Rutting	Low- Moderate	Moderate - High		
Cracking and Other Visual Distress	Low-Moderate	High	1. Milling and Rehabilitation should be carried out before overlay. 2. Use of Glass Fiber Paving Mat for prevention of reflective cracking.	
Roughness	Within desirable limits (2100mm/km)	Exceeds Desirable Limits	1. Micro Surfacing 2. Overlay	
Deflection/ Overlay Requirement	Low-Moderate	High	1. Micro Surfacing	1. Use of High Modulus Mixes, Highly Modified Asphalt to satisfy the future traffic load requirements. 2. DBM where strengthening is required.

Evaluation of Structures

- Inventory & Condition survey of structures are the two most essential requirements for O&M of highway structure
- Non- Destructive tests are conducted to evaluate the condition and material parameters

Inventory and Visual Condition Survey

Manual Inspection

Use of Drones for Visual Inspection

Use of Mobile Bridge Inspection Unit (MBIU)

Evaluation of Structures

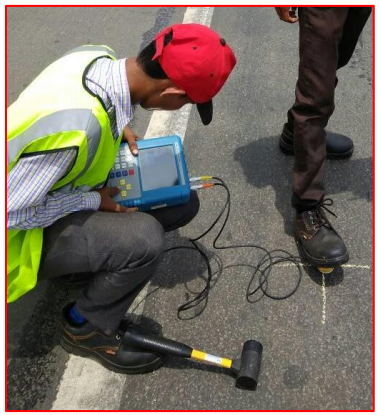
To evaluate health of existing highway structures several non destructive tests were carried out such as Ultra pulse Velocity, Rebound Hammer, Half–cell Potential, Carbonation Depth, Transient Dynamic Response and Infra red Thermography test.

Ultra Pulse Velocity (UPV) Test

Half Cell potential Test

Rebound Hammer Test

Transient Dynamic Response Test

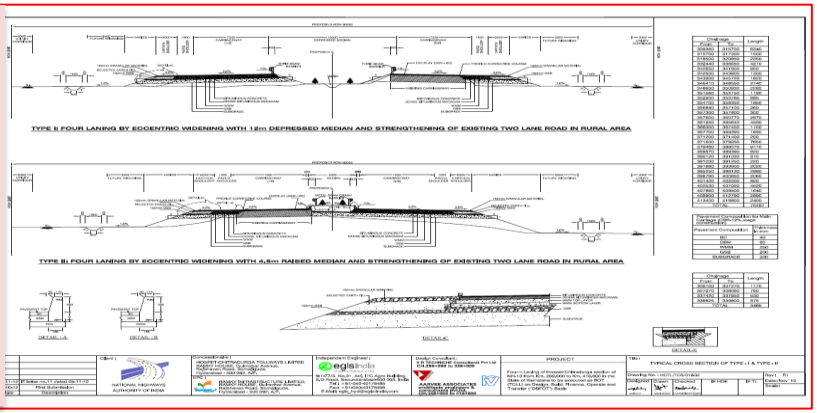


Carbonation Depth Test and Core Cutting

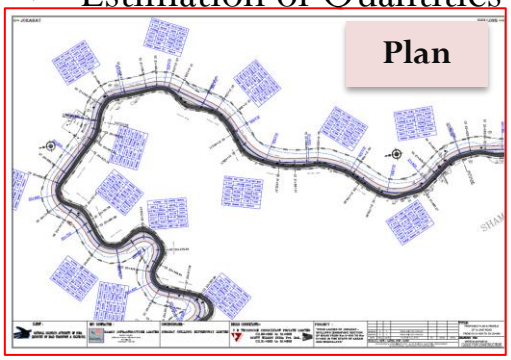
Detailed Engineering Design

- With expertise in both highway designing and traffic safety, we design highways and provide recommendations for improvement of existing highways considering all aspects of road Engineering as per the site-specific conditions.
- Advanced technology and methodology are used in the designing work - we use software like MX roads, AUTORUN, AUTOCAD, IIT PAVE, KGPBACK, CIRCLY and STADD
- **Services:** Following engineering services are provided for highway, pavements and bridge design.
  - ✓ Pre and Post Feasibility studies
  - ✓ Project Feasibility Studies (DPR)
  - ✓ Re-engineering – detailed designs and drawings
  - ✓ Proof-checking of structural designs
  - ✓ Estimation of Quantities and Project Cost

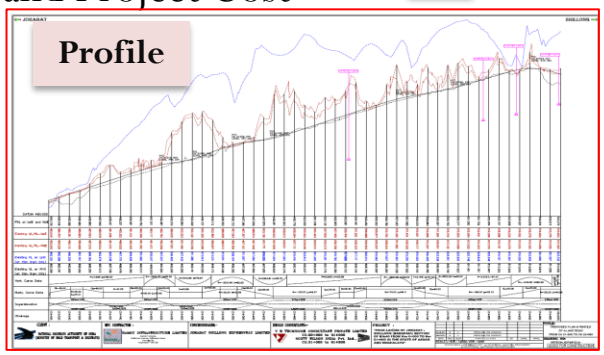
Typical Cross Sections



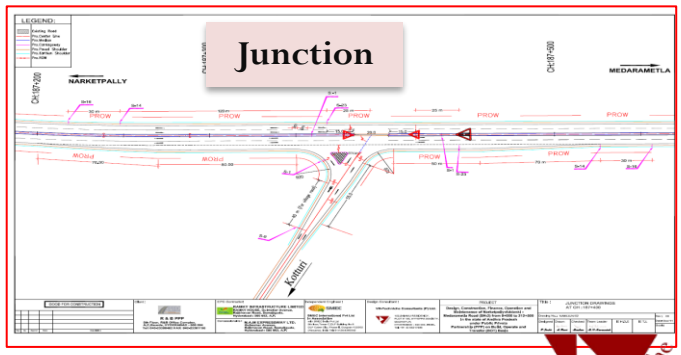
Plan



Profile



Junction



Investigations for Detailed Engineering Assignments

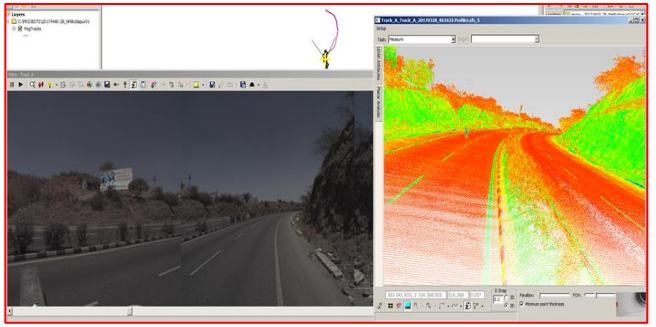
- Road Inventory Survey
- Road Condition Survey
- Hydraulic and Drain Condition Survey
- Bridge / Culvert Inventory Survey
- Bridge / Culvert Condition Survey
- Topographic Survey
- Axle Load Survey
- Material Investigations
- Pavement Investigations
- Hydraulic and Hydrological Investigations
- Geotechnical Investigations

Use of Mobile LiDAR for Design

V R TECHNICHE is using Mobile LiDAR for Engineering Design

Mobile LiDAR - Survey Grade Accuracy

- Multi-band GNSS Receivers
  - Higher accuracy – improves postprocessing
  - Better satellite geometry – improves postprocessing
- Inertial Processing
- System Calibration
  - Not based on computer vision
  - Same calibration process as high precision aerial mapping – field based
- Sensor bus architecture designed for stability and repeatability
- Strict adherence to timing – all data time-tagged to GNSS time



LiDAR Methodology

DGPS Survey

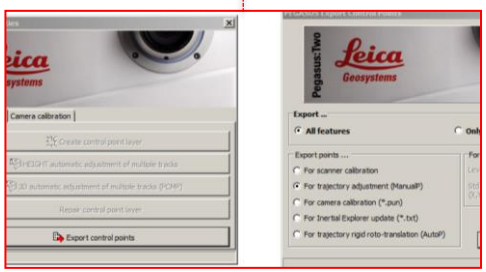
Traverse

Fly Level

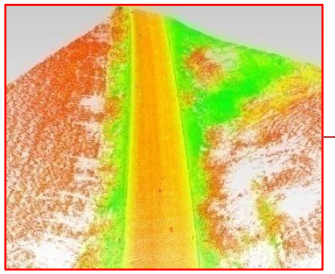
18	18	491850.626	1951265.303	49.567	TS16
19	19	492035.467	1951249.843	49.711	TS17
20	20	492277.302	1951237.699	48.901	TS18
21	21	492518.327	1951223.735	49.517	TS19
22	22	492740.814	1951212.288	50.440	TS20
23	23	492996.325	1951199.648	51.522	TS21
24	24	493231.004	1951219.364	51.688	TS22
25	25	493488.704	1951193.497	51.488	TS23
26	26	493620.347	1951199.720	50.837	GPS2
27	27	493739.285	1951212.583	51.385	GPS2A

Control Points

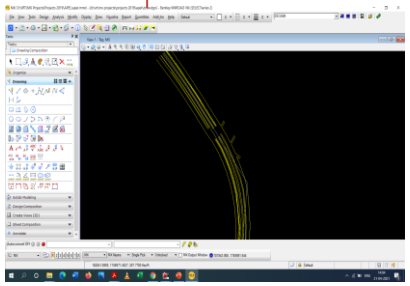
LiDAR Survey



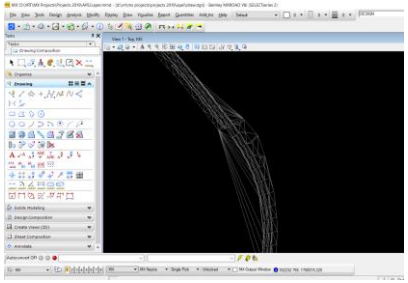
Manual P Adjustment



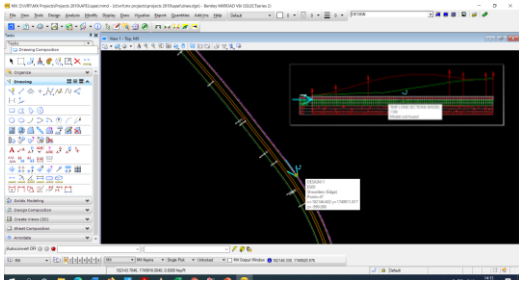
Accurate Cloud Data



Mx input from LiDAR



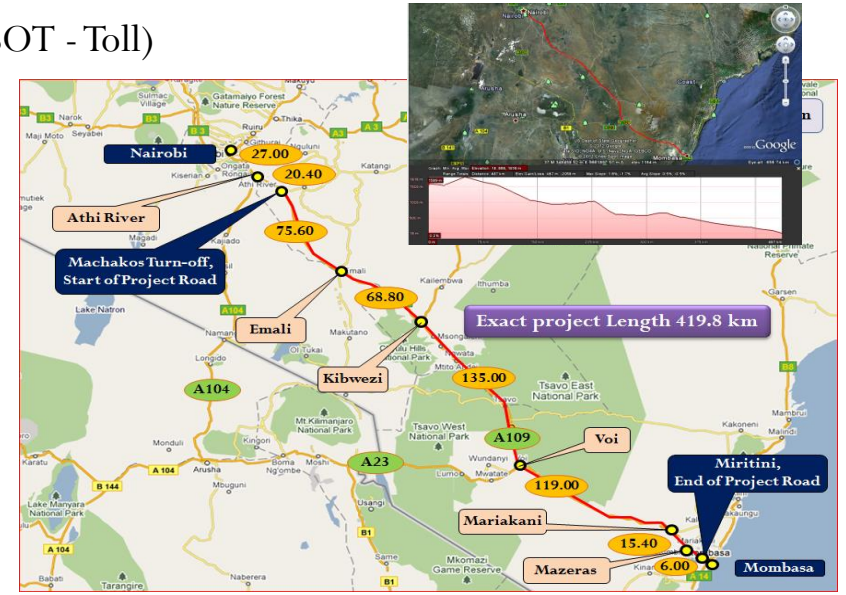
Digital Terrain Model (DTM)



Plan and Profile

Development of Nairobi – Mombasa Section of A109 on PPP

Scope of Project	
Total Length	419km
Client	Punj Lloyd (KeNHA)
Major Bridges	2
Minor Bridges	42
Flyovers, VUPs, PUPs	16
Culverts	836
Status	Project Scoping
Description of Services	**4-laning with Paved Shoulders** (BOT - Toll)



Phase – 1: Project Scoping Study

- Detailed traffic surveys and estimation of toll traffic
- Finalization of tolling strategy for the Project
- **<u>Recommendation of toll rates through analysis of road user cost savings</u>**
- Estimation of toll revenue
- Project scoping
- Preliminary design of the Project – alignment
- Preliminary design of the project – pavement
- Estimation of BOQ and Project Cost

Phase 2: Detailed Design

V R TECHNICHE is also advising on PPP Policy and Documentation

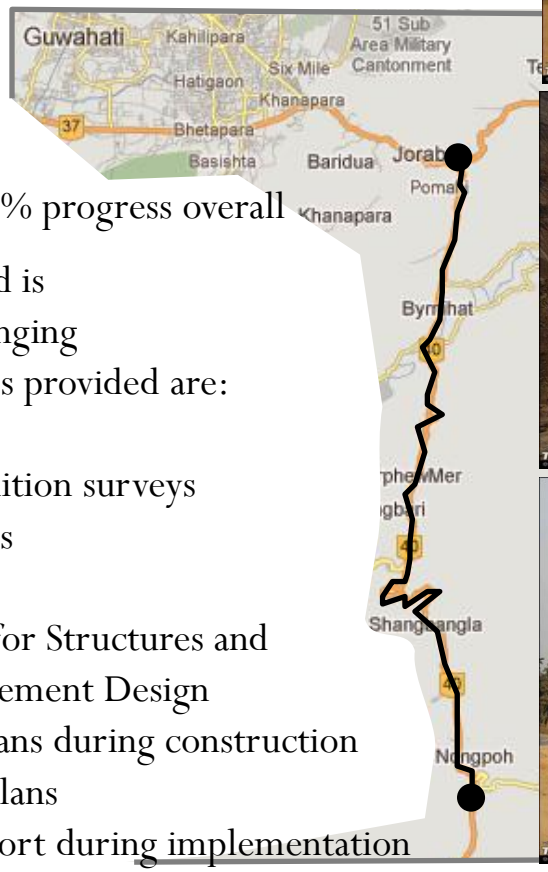
Re-engineering Projects: Jorabat – Shillong Section of NH40 (km 0 to km 30)

Scope of Project	**4-laning with Paved Shoulders** (BOT - Annuity)
Total Length	31.0km
Client	Ramky Group (for ITNL – Ramky JV)
Major Bridges	1
Minor Bridges	3
Culverts	108 pipe, 33 slab
Implementation Status	Hill cutting complete, 25% progress overall
Description of Services	The alignment of the road is Mostly in hills and challenging for designing. The services provided are:

- Topographic Surveys
- All inventory and condition surveys
- Pavement investigations
- Material investigations
- Designs and drawings for Structures and Highway as well as Pavement Design
- Traffic management plans during construction
- Signage and Marking Plans
- IC Approvals and Support during implementation

All designs and drawings approved by Client and IC

TECHNICHE Provided Pre-bid Services also



Re-engineering Projects: Narketpally –Medarametla Section of SH2 (km 166 to km 212.4)

Scope of Project	**4-laning with Paved Shoulders** (BOT - Toll)
Total Length	46.4km
Client	Ramky Group (for ITNL – Ramky JV)
Major Bridges	2
Minor Bridges	4
Culverts	64 pipe, 25 slab
PUP	4
Implementation Status	85% progress overall
Description of Services	The services provided are:

- Topographic Surveys
- All inventory and condition surveys
- Pavement investigations
- Material investigations
- Designs and drawings for Structures an
  Highway and Pavement Design
- Traffic management plans during consti
- Signage and Marking Plans
- Approvals from IC/APRDC
- Support during implementation

All designs and drawings, except for Drainage Design, approved by Client and IC

Re-engineering Projects: Hospet -Chitradurga Section of NH13 (km 299 to km 418.6)

Scope of Project	**4-laning with Paved Shoulders** (BOT - Toll)
Total Length	60.0km (Total Length with Concessionaire – 120km)
Client	Ramky Group
Major Bridges & ROBs	1 Major Bridge and 1 ROB
Minor Bridges	32
Culverts	137
Status	Designs approved by Client and IC, but Project is handed over back to NHAI

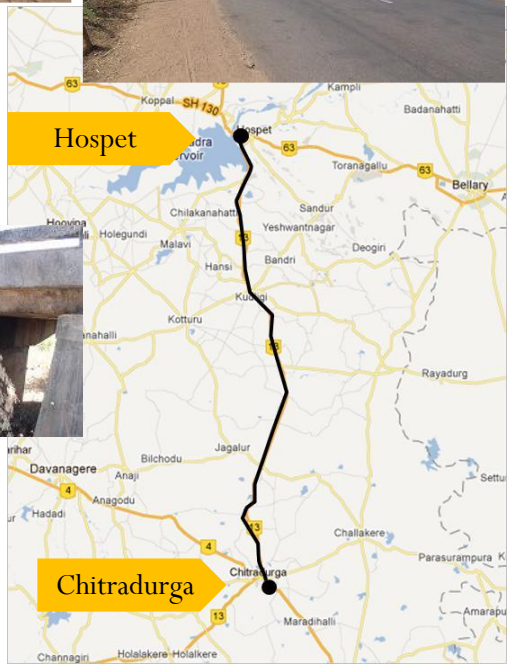
Description of Services

Investigations completed and Designs approved by Client and IC

TECHNICHE Provided Pre-bid Services also

The services provided are:

- All inventory and condition surveys
- Pavement investigations
- Material investigations
- Topographic Surveys
- Geotechnical investigations
- Designs and drawings for Structures and Highway as well as Pavement Design
- Traffic management plans during construction
- Signage and Marking Plans
- IC Approvals and Support during implementation



Re-engineering Projects: Cuddapah - Pulivendula Road (KP02, from km 15 to km 28)

Scope of Project	
Total Length	15km (with re-alignments)
Client	Sowbhagya Contractors
Major Bridges	1
Minor Bridges	2
Culverts	12
Implementation Status	Not known
Description of Services	

All designs and drawings were approved by APRDC and Project Implemented

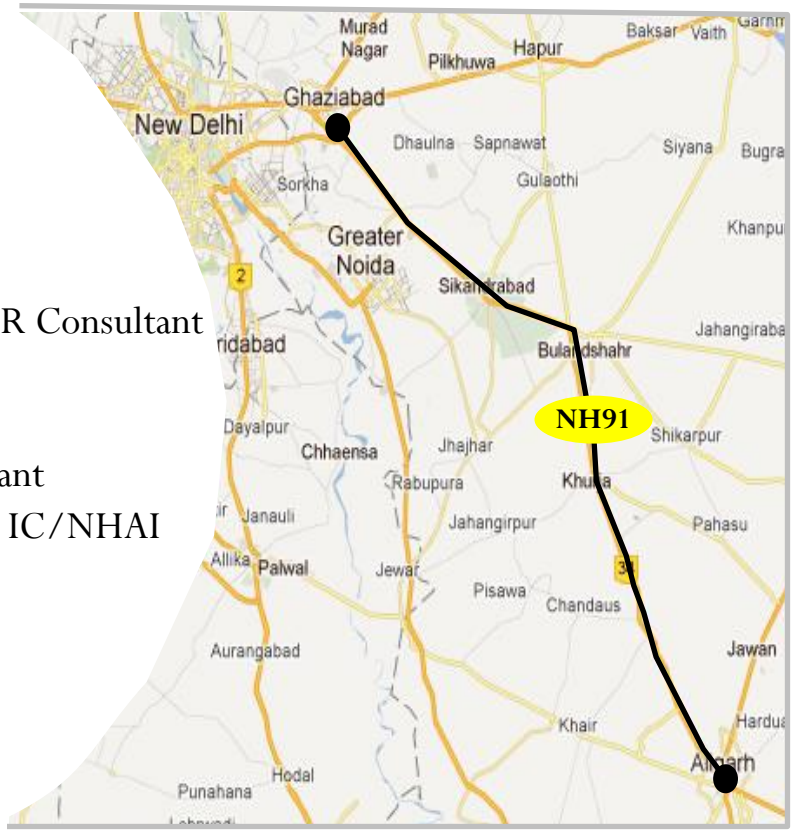
4-laning with Paved Shoulders (BOT - Annuity)

The services provided are:

- Topographic Surveys
- All inventory and condition surveys
- Pavement investigations
- Material investigations
- Designs and drawings for Structures and Highway and Pavement Design
- Traffic management plans during construction
- Signage and Marking Plans
- Approvals from APRDC

Proof Checking of Structures: Ghaziabad – Aligarh Section of NH91

Scope of Project	**4-laning with Paved Shoulders** (BOT - Toll)
Assignment	Proof Checking of Major Structures
Client	Gulfar Engineering & Contracting India Pvt Ltd
Grade Separators	4
VUPs	4
Description of Services	The services provided are: ▪ Detailed site reconnaissance of the site ▪ Review of Designs and Drawings of DPR Consultant appointed for the project by Gulfar ▪ Independent designs, where required ▪ Meetings with Proof Checking Consultant ▪ Approval of drawings for submission to IC/NHAI



Evaluation and Design of Highways, Pavements & Structures – *Key Highlights*

- Strong experience of over 100 Engineering assignments
- First Consultant to bring in advanced and scientific investigation methods in Engineering and TDD.
- First Technical Consultant to work on TOT Framework in India and rewrite maintenance specifications for Highway Projects
- Working with IIT Madras on Designing cost effective Bituminous Mixes

Key Highlights of Technical Advisory and Support

Technical Advisory and Support

Project Management Consulting

Lenders Advisory Services

Road Safety

Asset Management Frameworks

Technical Advisory and Support Framework

reference image A Sustainable Service Delivery Primer- THE ROLE OF OPERATIONS AND MAINTENANCE IN ASSET MANAGEMENT

O&M is an integral part of asset management. Here the Asset Management Framework shows how O&M activities are considered throughout the asset management process.

O&M in asset management requires continuous improvement to fulfill CA obligations. It is not an activity that can be done once and never again. It requires regular review and consideration i.e.- PDCA Approach.

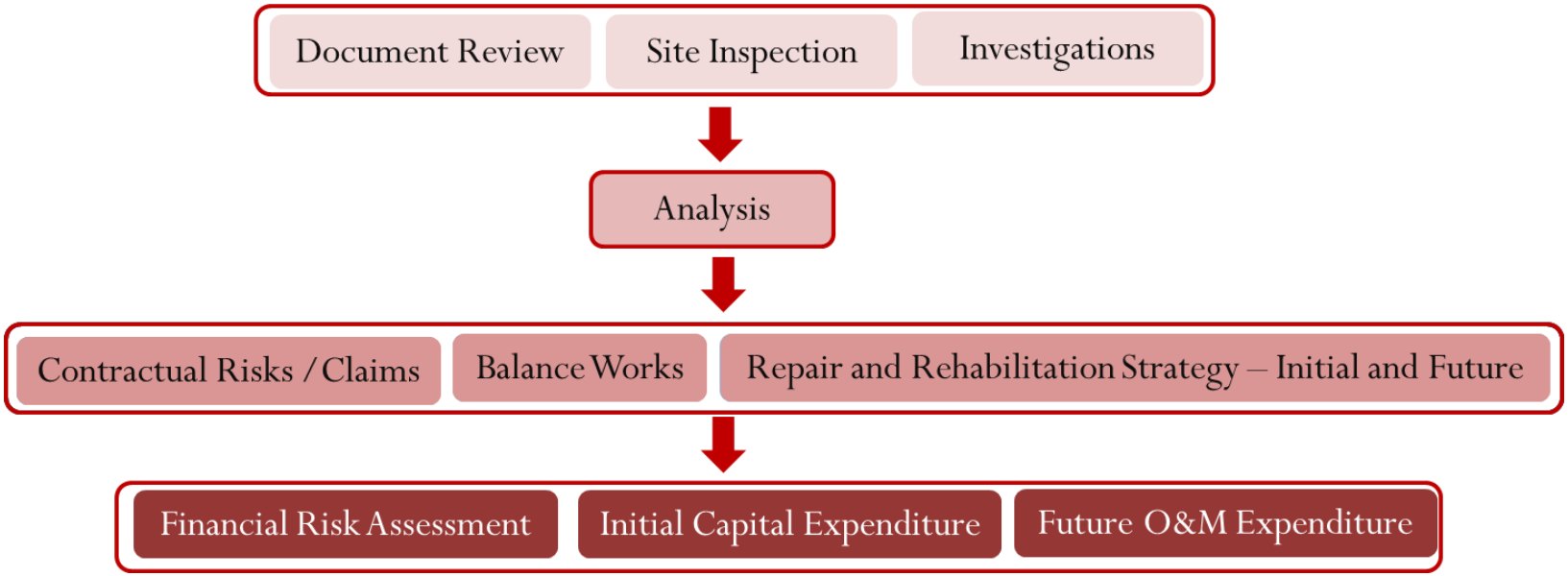
V R TECHNICHE has devised a detailed workflow and methodology for continuous monitoring and improving the O&M metrics for highway projects.

Project ASSESSMENT

Objective :

- ✓ Assessment of the physical condition including contractual issues to assist Lenders with proper evaluation of Highway Assets.
- ✓ To safeguard the interests of the Lenders / potential Investors by providing the required insight into current condition, obligations and future requirements.

Process Flow:



Project ASSESSMENT

Document Review

- ✓ Review of Project Documents - Concession Agreement, EPC Agreement, MPR, LIE and IE Reports
- ✓ Review of Project Correspondences and Identification of critical issues related to non-compliance of CA provisions, Claims, Penalties, Punch List Items and other Balance Works etc.

Site Inspection and Investigations

- ✓ Inventory Survey
- ✓ Condition Survey of Structures – Manual and Drone Videography
- ✓ Non- Destructive Testing of Structures
- ✓ Axle Load Survey, Investigation of Pavement Déstresses : Extent, Cause.
- ✓ Pavement Composition of the Carriageway
- ✓ Structural Strength and Functional Properties of the pavement
- ✓ Material Characterization of Pavement Materials, Structural Materials.
- ✓ Road Safety Audit
- ✓ Toll Plaza Systems and HTMS Audit

Analysis

- ✓ Deviation of Actual Construction Works and other components as compared to CA provisions
- ✓ Condition Evaluation of Structures and Maintenance Needs
- ✓ Condition Evaluation, Remaining Life of Pavement and Maintenance Requirements
- ✓ Condition Evaluation of TMS and HTMS Systems and Maintenance Requirements
- ✓ Accident Analysis and Identification of Safety Improvement Requirement – location specific, general
- ✓ Identification of Non Compliance of O&M Activities
- ✓ Evaluation of Current O&M Expenses for the Project based on Project Financials
- ✓ Identification of Claims and Penalties

Project ASSESSMENT

Cost Estimation

- ✓ Determination of Initial Maintenance Cost for all assets in the Project
- ✓ Maintenance Strategy for Pavement for Future
- ✓ Estimation of Operating, Routine Maintenance and Periodic Maintenance Expenses for the Project
- ✓ Estimation of Balance Quantities and Cost
- ✓ Estimation of Cost of Punch List Items
- ✓ Estimation of Upgradation Cost
- ✓ Evaluation of Claims and Penalties based on Project Correspondences

Assessment of Existing Management Practices

- ✓ Review O&M practices to better understand their economy, efficiency, and effectiveness.
- ✓ Assess the human and financial resources required to maintain the desired level of service and identify gaps in resources provided for O&M to address any service gaps.

Project PLAN

Objective:

- ✓ Development of a discipline of making sustainable decision for the asset based on Technical Parameters and Contractual Provisions.
- ✓ Determining how to extract the maximum value from the asset across their entire lifecycle.
- ✓ Prescribing the most economical solutions for lasting success.
- ✓ Not necessarily minimising costs or maximising performance but optimising the same.

Project PLAN for Balance Works

Activities for Balance Works:

- ✓ Preparation of completion plan for balance works
- ✓ Restructuring of Contracts for pending EPC works with introduction of performance parameters or evaluation of possibility of change of contractor if required.
- ✓ Evaluation of new EPC contractor
- ✓ Preparation of Monitoring and Reporting Mechanism – ***setting up of App based Construction Management System.***
- ✓ Identification of gaps in performance of resources at SPV level and preparation of restructuring/augmentation plan for the human resources required to maintain the desired level of progress and efficiency.

Project PLAN for O&M

Activities for O&M:

- ✓ Document where improvements in the efficiency and effectiveness of O&M are needed and how the organization will make these improvements.
- ✓ Methodical approach to routine maintenance along with usage of newer, cost efficient road maintenance technology.
- ✓ Develop work plans, processes, and / or procedures to achieve the improvements in O&M activities identified in the asset management policy and strategy.
- ✓ Optimization of cost and time through the use of Mobile Maintenance Equipment and Machinery instead of adopting a manual process.
- ✓ Restructuring of O&M Contracts with introduction of performance parameters.
- ✓ Evaluation of O&M Contractors based on past performance and identification of needs for replacement.
- ✓ Building of Inhouse team for Routine Maintenance activities.
- ✓ Periodic /Major Maintenance Strategy
- ✓ Bid Documentation and Bid Process Management for MM works
- ✓ Evaluation and selection of MM contractor
- ✓ Preparation of Monitoring and Reporting Mechanism – ***setting up of App based Asset Management System.***

Project IMPLEMENTATION

Objective:

- ✓ Implement the Project objectives identified in the PLAN activities.
- ✓ Measure organization's performance in achieving strategic objectives and service delivery goals.

Monitoring:

- ✓ Onsite Support with dedicated Project Team from VRT
- ✓ Periodic Visits by VRT team
  - Weekly
  - Bi-Monthly
  - Monthly
  - Quarterly

Project IMPLEMENTATION for Balance Works

Activities for Balance Works :

- ✓ PMC (Project Management Consultancy) team at site for regular monitoring of pending works in terms of progress, quality and safety.
- ✓ Design Support for pending approvals from IC/Authority.
- ✓ Updation of Construction Management Application/Portal to Assist and Advise the lenders about the progress of work on a regular basis
- ✓ Certification of Bills and monitoring of Expenditure schedule and tracking the cost overruns in the project
- ✓ Certification of the complete utilization of previous disbursements
- ✓ Assessment of variation orders, if any, that may have impact on the EPC
- ✓ Review the traffic management program during construction and verify the compliance on regular basis.

Project IMPLEMENTATION for O&M

Activities for O&M:

- ✓ Review the actions identified in the asset management policy, strategy, and plans and monitor which ones are achieved, which ones are in the process of being achieved, and which are no longer relevant or cannot be achieved.
- ✓ Updation of Asset Management System Application/Portal to track indicators in the Asset Management System that will support reporting to Lender by service area, for example, targets for service life, operating cost reductions, asset performance, and employee engagement as well as general progress measures around current performance and future preparedness.
- ✓ Certification of O&M Bills and monitoring of Expenditure schedule and tracking same with Budgetary provisions.
- ✓ PMC (Project Management Consultancy) team at site for regular monitoring of MM works in terms of progress, quality and safety.
- ✓ Certification the complete utilization of previous disbursements and assessment of variation orders if any.
- ✓ Communicate results of measurement processes. Meetings with internal stakeholders to re-establish priorities and maintain momentum in achieving objectives.
- ✓ Train staff on new or updated policy, strategy, plans, and procedures.

Key Highlights

- ✓ Appointed as LIE in more than 75 Assignments till date
- ✓ Appointed as LIE by Yes Bank for DMRC Phase 4 construction (underground Tunnel section from Hazrat Nizamuddin to Bhikaji Kama and Naraiana Section -10 km) – First of its kind assignment wherein Yes Bank did not ask for any pre qualification in terms of working in metro projects
- ✓ Working as LIE for 27 projects (FY21-22) which includes BOT (Toll), BOT (Annuity) HAM Projects in various stages namely Construction, O&M etc.
- ✓ **Currently involved in fulltime monitoring of O&M Activities including QA/QC services for MM for 11 projects**
- ✓ Appointment of LIE for 4 projects under InvIT
- ✓ Preferred consultant for Lenders - *Existing LIE was replaced by VRT in multiple projects*

Kundli Manesar Expressway

Metro Tunnel- DMRC Phase IV

Case Studies of Improvement

Project I

- **4 Lane BOT Annuity Project, Length:70km, Location: Jharkhand, Authority: NHAI**
- **Onsite Monitoring by VRT for O&M and MM**

Improvements/Developments in O&M post appointment of LIE

- ✓ LIE is ensuring that the Concessionaire is attending all issues highlighted by NHAI. A timeline is given to the Concessionaire and payment is directly made to the vendor.
- ✓ Post appointment, Full Annuity has been released
- ✓ NHAI/IC withheld some amount from previous annuity due to non fulfilling the O&M obligation prior to LIE appointment in the project.
- ✓ All issues is expected to be resolved within given timeline and withheld amount will get released along with upcoming annuity.
- ✓ Project has moved to green from amber in internal rating.

Case Studies of Improvement

Project II

6 lane BOT Toll Project, Length: 26 km, Location: Karnataka, Client: NHAI

- **Onsite Monitoring by VRT for O&M and MM**

Improvements/Developments in O&M post appointment of LIE

- ✓ Major Maintenance Contractor is finalized jointly by LIE, Lenders and the Concessionaire
- ✓ LD on routine O&M activities is reduced

Case Studies of Improvement

Project III

4 lane BOT Annuity Project, Length:70 km, Location: Uttar Pradesh, Client: NHAI

- **Weekly Monitoring by VRT for O&M**

Improvements/Developments in O&M post appointment of LIE

- ✓ LIE team is monitoring the O&M activities as there is no technical staff available at SPV
- ✓ Prior to appointment of VRT, IC has recommended for withhold amount of ~Rs. 2 Cr in their latest annuity (Rs 50 Crs) recommendation.
- ✓ Improved co-ordination, planning, speedy implementation and monitoring resolved pending issues within 15 days. As a result, NHAI did not withhold the amount in Annuity released.
- ✓ O&M Contractor are appointment after LIE and Lenders verification
- ✓ Payment is being paid directly to O&M vendors after verification by LIE

Project Management Consulting

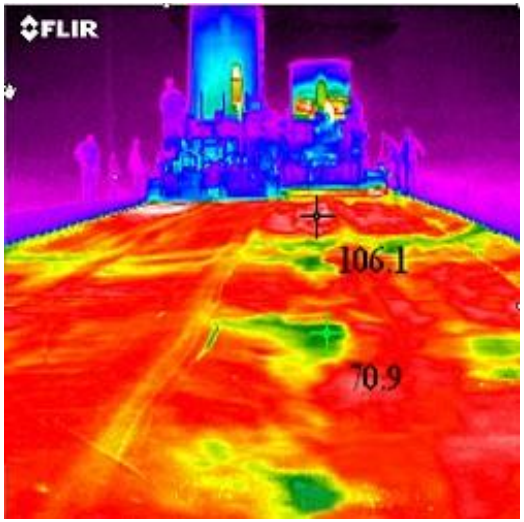
- **Objective:** Project Management Consultancy services include planning, QA/QC, supervision and safety management during construction as well as maintenance of Highway Projects
- **Scope of Services:** Our professionals observe and test
  - ✓ Sub-grade preparation;
  - ✓ Installation of sub-grade drainage systems;
  - ✓ Placement and compaction of aggregate base course;
  - ✓ Placement and compaction of bituminous materials, and concrete materials
- Undertake plant inspection, testing of materials prior to the start of production
- Monitor material handling procedures, mix proportions, mixing temperatures and mixing time during production, and sample the final mixtures to ensure conformance with project requirements and approved mix designs
- Supervise construction activities at site with adherence to developed Safety SOPs, proper methodology and quality control processes to ensure long term performance. Use of advanced equipment to ensure quality.
- Providing expertise and scientific knowledge in application of advanced materials and new technologies in field which will be beneficial in optimising life cycle costs

Project Management Consulting – *Key Highlights*

- Strong Technical Team of more than 35 members dedicated for PMC services
- Currently undertaking 8 under-construction projects under HAM
- Successfully implemented new materials/mixes like Highly Modified Asphalt (HiMA), FEP additive, Stone Matrix Asphalt, geotextiles and superior technologies namely Cold In Place Recycling, Recycling, Microsurfacing etc. ***HiMA was selected for the GOLD AWARD in Innovation Category in Excellence Awards of NHAI.***
- **With implementation of technology based Proactive safety management SOPs, achieved incident free MM works and received appreciation from various stakeholders**

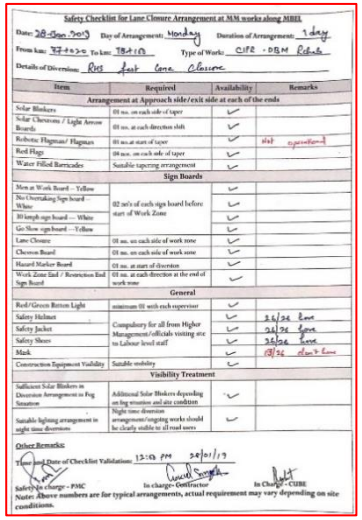
Project Management Consulting – *Key Highlights*

Rigorous Laboratory Testing



Thermal Image

Non- Nuclear Density Gauge



Safety Checklist for Lane Closure Arrangement at MM works along MBEL

Date: 28-Dec-2013 Day of Arrangement: Monday Duration of Arrangement: 1 day
From km: 37+620 To km: 38+10 Type of Work: CIPE - DBM Rehab
Details of Diversion: RHS fast lane Closure

Item	Required	Availability	Remarks
Arrangement at Approach side/exit side at each of the ends			
Solar Blinkers	01 no. on each side of taper	✓	
Solar Chevrons / Light Arrow Boards	01 no. at each direction shift	✓	
Robotic Flagman/ Flagman	01 no at start of taper	✓	not operational
Red Flags	04 nos. on each side of taper	✓	
Water Filled Barricades	Suitable tapering arrangement	✓	
Sign Boards			
Men at Work Board – Yellow	02 no's of each sign board before start of Work Zone	✓	
No Overtaking Sign board – White		✓	
80 kmph sign board – White		✓	
Go Slow sign board – Yellow		✓	
Lane Closure	01 no. on each side of work zone	✓	
Chevron Board	01 no. on each side of work zone	✓	
Hazard Marker Board	01 no. at start of diversion	✓	
Work Zone End / Restriction End Sign Board	01 no. at each direction at the end of work zone	✓	
General			
Red/Green Retro Light	minimum 01 with each supervisor	✓	
Safety Helmet	Compulsory for all from Higher Management/officials visiting site to Labour level staff	✓	26/12 Done
Safety Jacket		✓	26/12 Done
Safety Shoes		✓	26/12 Done
Mask		✓	28/12 Done
Construction Equipment Visibility	Suitable visibility	✓	
Visibility Treatment			
Sufficient Solar Blinkers in Diversion Arrangement to Peg Situation	Additional Solar Blinkers depending on fog situation and site condition	✓	
Suitable lighting arrangement in night time diversion	Night time diversion arrangement/ongoing works should be clearly visible to all road users	✓	

Other Remarks:

Time and Date of Checklist Validation: 13:00 PM 28/01/13

Safety in charge - PMC | In charge- Contractor | In Charge - CIPE

Note: Above numbers are for typical arrangements, actual requirement may vary depending on site conditions.

Development of Proactive SOPs for Safety Implementations and Ensuring adherence

techniche

Project Management Consulting – *Key Highlights*

- **Proactive Safety Implementations on Number of Projects have seen following tangible as well as Intangible benefits -**
  - ✓ *Minimal Incidents. Backup of Safety Database in case of any incidents even after best possible arrangements.*
  - ✓ *Uninterrupted Work and No delays on account of incidents due to fault of Safety Arrangements. Saving from idling costs of men-machinery at work sites.*
  - ✓ *Reduced Legal issues.*
  - ✓ *Improved Safety Culture useful to create positive Company Image in Community*
  - ✓ *Earning support from various stakeholders such as Highway Authorities, Enforcing Agencies*
  - ✓ *Improved community acceptance and support from local residents*
  - ✓ ***Saving Precious Human Lives – Road users as well as Human at work zones***

Key Highlights of Services

- Travel Demand Estimation
- Traffic and Transportation Planning
- Evaluation and Design of Highways, Pavements & Structures
- Operation and Maintenance Strategy
- Project Management Consulting
- Lenders Advisory Services
- **Road Safety**
- Asset Management Frameworks
- Intelligent Transportation Systems

Road Safety - *Scope of Services*

- **Objectives:** To provide Technology and Knowledge driven services in Road Safety sector for various stakeholders at various stages of Road Development
- **Road Safety Audit**
  - ✓ Road Safety Audit at Pre-Feasibility, Feasibility and Design Stage
  - ✓ Road Safety Inspection at Construction, Pre-Opening and Operation stage
  - ✓ Development of Safety Improvement Proposals
- **O&M Stage Road Safety Support**
  - ✓ Traffic Management Plans and Strategy for Construction Works
  - ✓ Road Safety Inspection of Major Maintenance Works
  - ✓ Periodical Safety Inspection of Operational Projects
  - ✓ Development of Project Operation SOPs considering Safety Aspects
  - ✓ Inspection of Incident Management System and setting up SOPs for Incident Management
  - ✓ Road Safety related Training

- ✓ Formulated Road Traffic Safety Management System (RTSMS) as per ISO:39001-2012.
- ✓ Within next few months, upon Certification, V R TECHNICHE will be in the list of less than 10 organizations across the country having this ISO Certification.

Road Safety - *Key Highlights*

- 2 numbers of IAHE-MORTH Certified Road Safety Auditors in the team
- Strong understanding of National and International specifications related to Road Safety
- Active participation in Road Safety research and development; Trainings
- **Use of Technology for better understanding of Safety Issues:**
  - ✓ Videography of Highway with the driver's eye level view *(more than 3000 kms so far..)*
  - ✓ Videography / Images of Study Section with the Bird's eye level view (Drone Camera) *(more than 1200 kms so far..)*
  - ✓ Number of other Technological Tools

Video

Video




Initiated Technology usage in Road Safety Audits, which are **very helpful to reduce Subjectivity from the field of Road Safety Engineering**.

Key Highlights of Services

- Travel Demand Estimation
- Traffic and Transportation Planning
- Evaluation and Design of Highways, Pavements & Structures
- Operation and Maintenance Strategy
- Project Management Consulting
- Lenders Advisory Services
- Road Safety
- **Asset Management Frameworks**
- Intelligent Transportation Systems

Asset Management Framework – *Key Highlights*

- **Strong Experience in -**
  - ✓ Development of Asset Management Framework
  - ✓ SOPs for Asset Management
  - ✓ Evaluation and Modification of O&M Processes

- Development of Asset Management Framework for Performance Management of Highway Projects for NHAI as part of Toll Operate Transfer (TOT) Bundle-1. *(Schedule-F: Operation and Maintenance Requirements)*
- *Development and Implementation of Highway Asset Management System*

Asset Management Framework – *Key Highlights*

Development and Implementation of *Highway Asset Management Platform*

V R TECHNICHE

Technical Team having strong Experience in Highway Design, O&M and Maintenance Strategies

Gamenous Pvt Ltd

Software Team having experience in various Apps and live tracking tools

Advantages of RoadAID Platform:

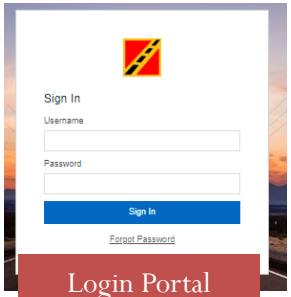
- **Brings transparency to whole system with live updates.**
- **Saves Administrators and HQ time with easy communication channel to follow up on all works on site.**
- **Secure and Geo-tagged proof of works can be easily uploaded through App.**
- **Record all data for individual assets and monitor their status for historical analysis.**
- **Dedicated software development team to monitor platform and add new features**

- ✓ Currently, RAID is under use along 7 highway projects across India by two large investor firms *(Total Length of Highway ~800 km)*
- ✓ In addition to above, working on various Technological Tools such as –*Automatic Asset Detection and Evaluation Module, Highway Construction Management Tool - BuildAID, etc..*

Asset Management Framework – *Key Highlights*

Implementation of App based O&M Management for LIE and PMC Projects

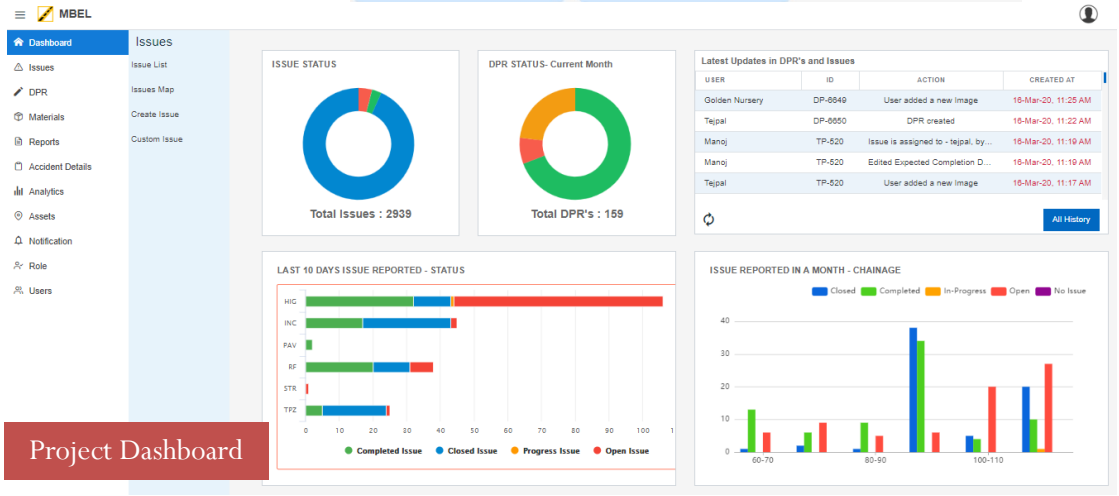
- ✓ Initiated implementing Android App based Issue Reporting mechanism for LIE and PMC Projects.
- ✓ *This will enable documenting, storing, maintaining map linked issues along the highway on one platform with time-stamped photographs taken through App.*



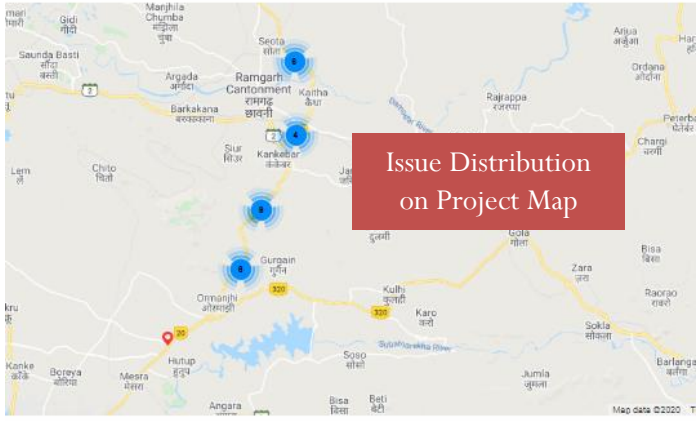
Login Portal

Asset List

Issue List

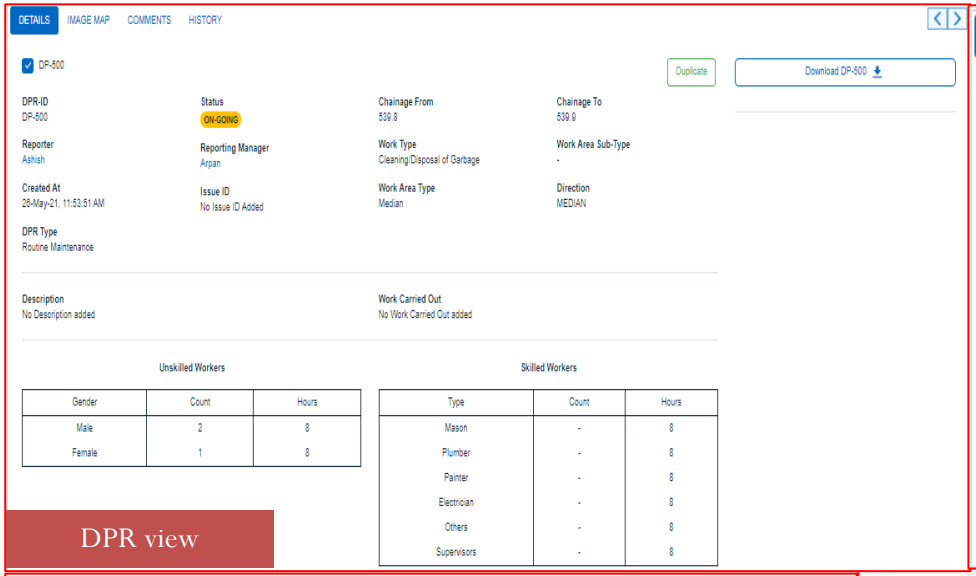


Project Dashboard

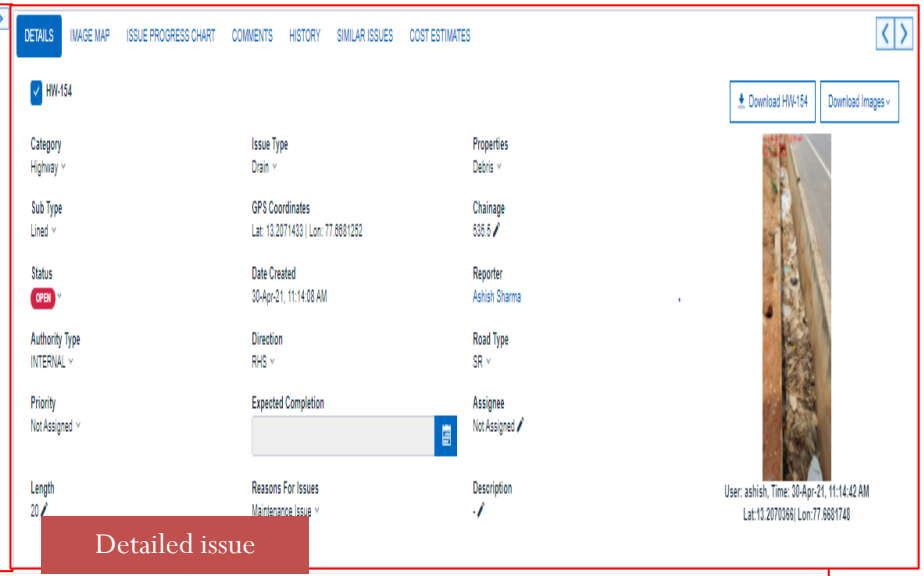


Issue Distribution on Project Map

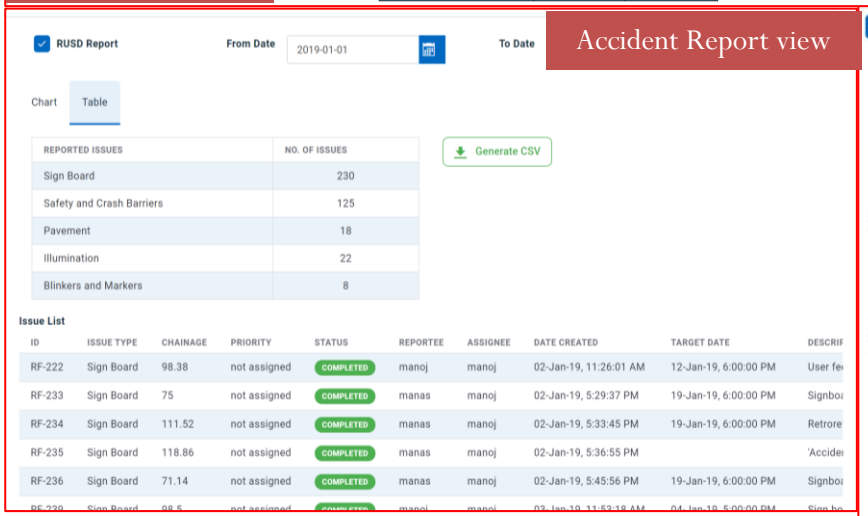
Asset Management Framework – *Key Highlights*



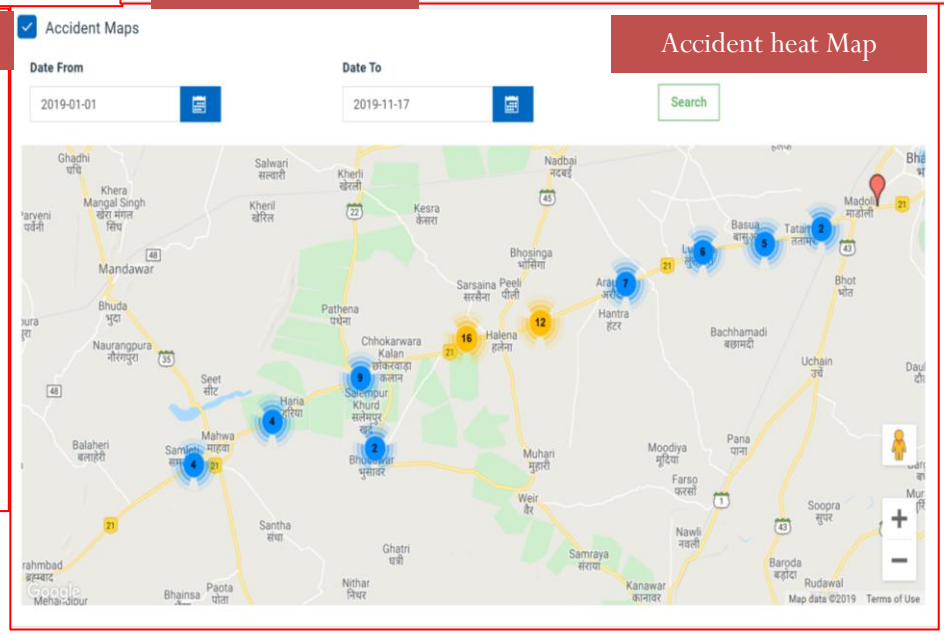
DPR view



Detailed issue



Accident Report view



Accident heat Map

Key Highlights of Services

- Travel Demand Estimation
- Traffic and Transportation Planning
- Evaluation and Design of Highways, Pavements & Structures
- Operation and Maintenance Strategy
- Project Management Consulting
- Lenders Advisory Services
- Road Safety
- Asset Management Frameworks
- **Intelligent Transportation Systems**

Intelligent Transportation System – *Key Highlights*

- **V R TECHNICHE provides following services in ITS**
  - ✓ Audit of Tolling Management System (TMS)
  - ✓ Review and Improvement of Tolling Operations
  - ✓ Designing of Advanced Traffic Management System

- *Carried out TMS Audit for more than 60 toll plazas across India*
- *BHARI Infra Pvt Ltd was a Brain Child of V R TECHNICHE, which currently handles ITS Business across the Country*

Contributions of V R TECHNICHE in Consulting

- ✓ Auditable and Automatic Traffic Counting Technology
- ✓ Network Based Traffic Estimation for Rural Highways
- ✓ Introduction of Scientific Evaluation of Highway Assets with State-of-the-art technologies
- ✓ Framework for Performance Based Asset Evaluation and Maintenance
- ✓ Implementation of technology based system of SOPs for Quality Assessment & Safety arrangement during execution
- ✓ Introduction of new and high performance materials to Indian Highway Sector
- ✓ Development & Implementation of Asset Management Systems in Indian Highway Sector

Key Impact Study of V R TECHNICHE –TOT Bundle I

Scope of Project	**Preparation of DPR on physical condition of 9 stretches awarded in 1st Bundle of Toll Operate and Transfer Model**
Total Length	680 km
Client	National Highway Authority of India (NHAI)
Status	**Bundle-I was awarded for Rs. 9,681 Crore, against initial estimated concession value (IECV) of Rs. 6258 Crore.**
Description of Services	▪ Technical Consultant for preparation of DPR as part of Bid Document for TOT-1 for NHAI

Andhra Pradesh

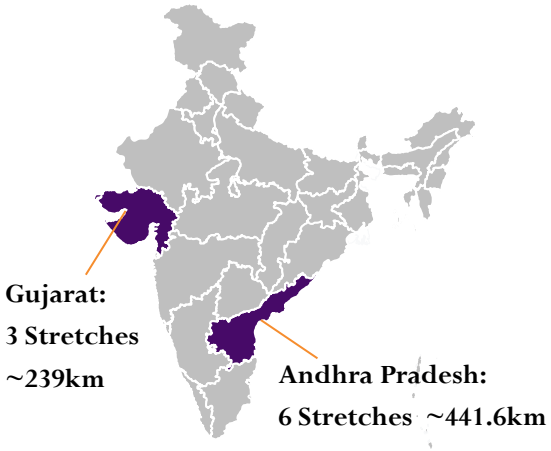
Stretch	Length (km)
Siddhantham – Gundugolanu	71.95
Diwancheruvu – Siddhantham	49.04
Annavaram (Tuni) – Diwancheruvu	70.98
Ankapalli – Annavaram (Tuni)	88.53
Ichhapuram – Narsannapeta	96.70
Puintola – Ichhapuram	64.40
Total	**441.6**

Gujarat

Stretch	Length (Km)
Bamanbore – Garamore	71.94
Garamore – Samakhaiyali	51.46
Porbandar – Bhiladi - Jetpur	115.64
Total	**239.0**

Key Achievements:

- Elaborate DPR and Technical & Maintenance Schedules prepared by V R TECHNICHE have received positive responses
- First time NHAI DPRs considered –ve growth rates for Goods Vehicles based on composition changes
- High quality drone video captured along the project stretches helped bidders to visualize the projects without visiting site



Team Members

M Bhavana Reddy
Managing Director

T. R. Reddy (M.Tech)
Principal Consultant - Structure Exp. 36 yrs.

Dhiraj Prakash Sethi
(M.Tech) Principal Consultant – Traffic and Safety Exp. 14 yrs.

Amol A Deshmukh
(M.Tech) Principal Consultant – Traffic and Transportation Exp. 13 yrs

Arpan Ghosh (M.Tech.)
(M.Tech) Principal Consultant - Technical (Pavements) Exp. 12 yrs.

Vankadothu Saidulu
(M.Tech), Managing Consultant – Highway Design Exp. 15 yrs.

Shravan Kumar Guduru
***(M.S)**, Managing Consultant – Technical, Exp. 13 yrs.*

Ananth Kumar Vuggirala
***(M.S)**, Managing Consultant - Structure Exp. 13 yrs.*

Sai Suman Poojari
***(M.Tech)**, Managing Consultant – Highway Design, Exp. 13 yrs.*

Priyanka Khan
***(M.Tech)**, Managing Consultant Exp. 10 yrs.*

Sudini Venkatesh
***(B.E,)**, Senior Consultant – Technical Exp. 12 yrs.*

In addition to above, Team of 120 Professionals

International Projects

S. No.	Country	Client	Project	Year
1	**Tanzania**	CRISIL Risk and Infrastructure Solutions Limited	Traffic Expert Services for Transaction Advisory under PPP in respect of the Kigamboni Bridge Project in Dar es Salaam	2010
2	**Indonesia**	Punj Llyod Ltd	Traffic Study for Pemalang - Pekalogan - Batang Section of Java Toll Road Projects	2011
3	**Kenya**	Intex Construction Ltd and Punj Lloyd Infrastructure Limited	*Pre-feasibility study for 4 lanning of Mombasa-Nairobi Section of A-109 to be developed on a PPP Basis (Length – 420 km) – Traffic and Engineering*	2012
4	**Bhutan**	International Finance Corporation, India (IFC-India)	Technical Consultant for pre-feasibility and scoping study for parking under PPP at Thimphu, Bhutan	2012

International Projects

S. No.	Country	Client	Project	Year
5	**Gabon**	Gabon Special Economic Zone SA	Traffic Study for Proposed Owendo-PK-15 Peripheral Road in Gabon	2014
6	**Kenya**	Intercontinental Consultants and Technocrats Pvt. Ltd	Technology Support for carrying out Video Based Traffic Counts for the project 'Nairobi - Nakuru(A104) Highway, Kenya	2015
7	**Ghana**	Pearl Consultants Ltd	Traffic Study for DPR of Lot-2 of Abidjan – Lagos Corridor in Ghana (Length-466km)	2019 (Ongoing)

Has experience of working in different geographies around the world, indicating quick adaptability

THANK YOU

V R TECHNICHE Consultants Private Limited

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