Project iRASTE

Revolutionizing Road Safety using Artificial Intelligence: A Case Study

Dr. S. Velmurugan, *Chief Scientist & Head, TES Division, CSIR - CRRI, New Delhi*

Mr. Dev Singh Thakur, INAI, IIIT Hyderabad, Hyderabad

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www.indiairf.com india@irf.org.in

Presentation Outline

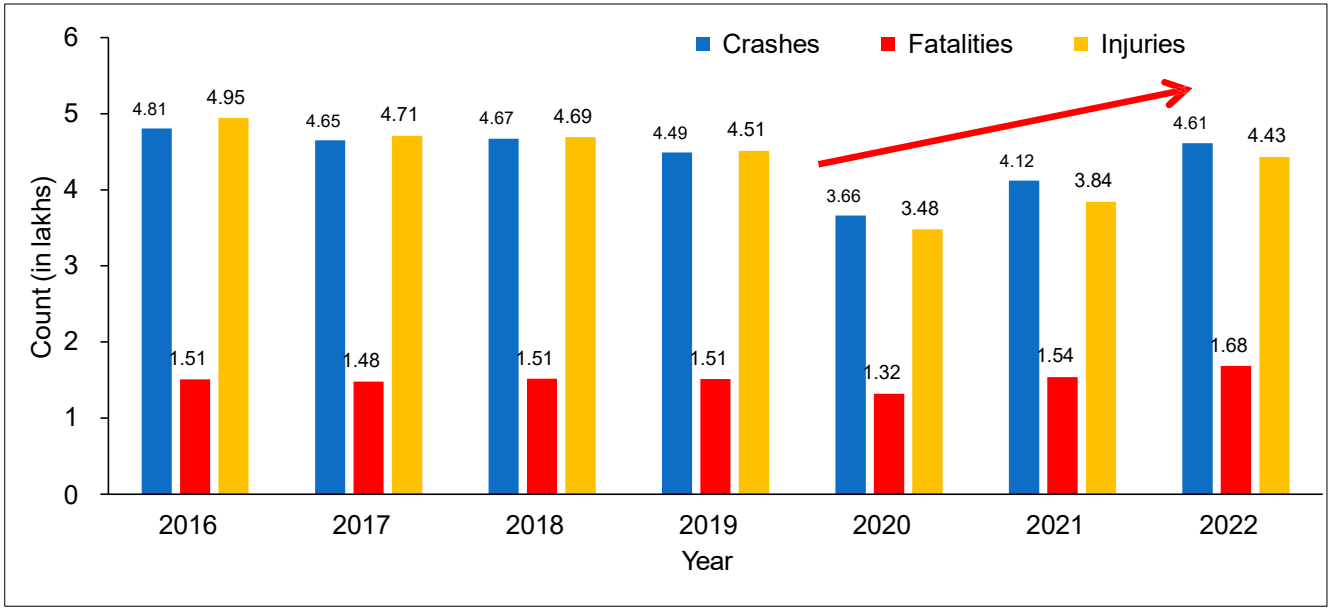
Project iRASTE

- Preamble & Significance of the Study
- About Project iRASTE: A Pilot Study
- Artificial Intelligence powered ADAS to tackle Road Safety
- Vehicle Safety Vector & Driver Safety Performance
- Mobility Safety Vector
- Infrastructure Safety Vector
  - Status of the iRASTE Blackspot Action Plan: Couple of Case Studies
  - Economic Benefit Assessment of Black Spot Improvements
- Education, Awareness Campaign and Emergency Care
- Overall Outcome of Project iRASTE

Preamble & Significance of the Study

- As per WHO, each year, 1.19 million global road fatalities result from road crashes, mainly affecting individuals aged between 5 to 29. Out of the above, 92 % occur in Low and Middle Income Countries *(LMIC)*, despite the above countries have only 60 % of the world's vehicles.
- India has the dubious distinction of accounting for the maximum *i.e. 11 % road fatalities*

Indian road crash statistics: 2016 to 22



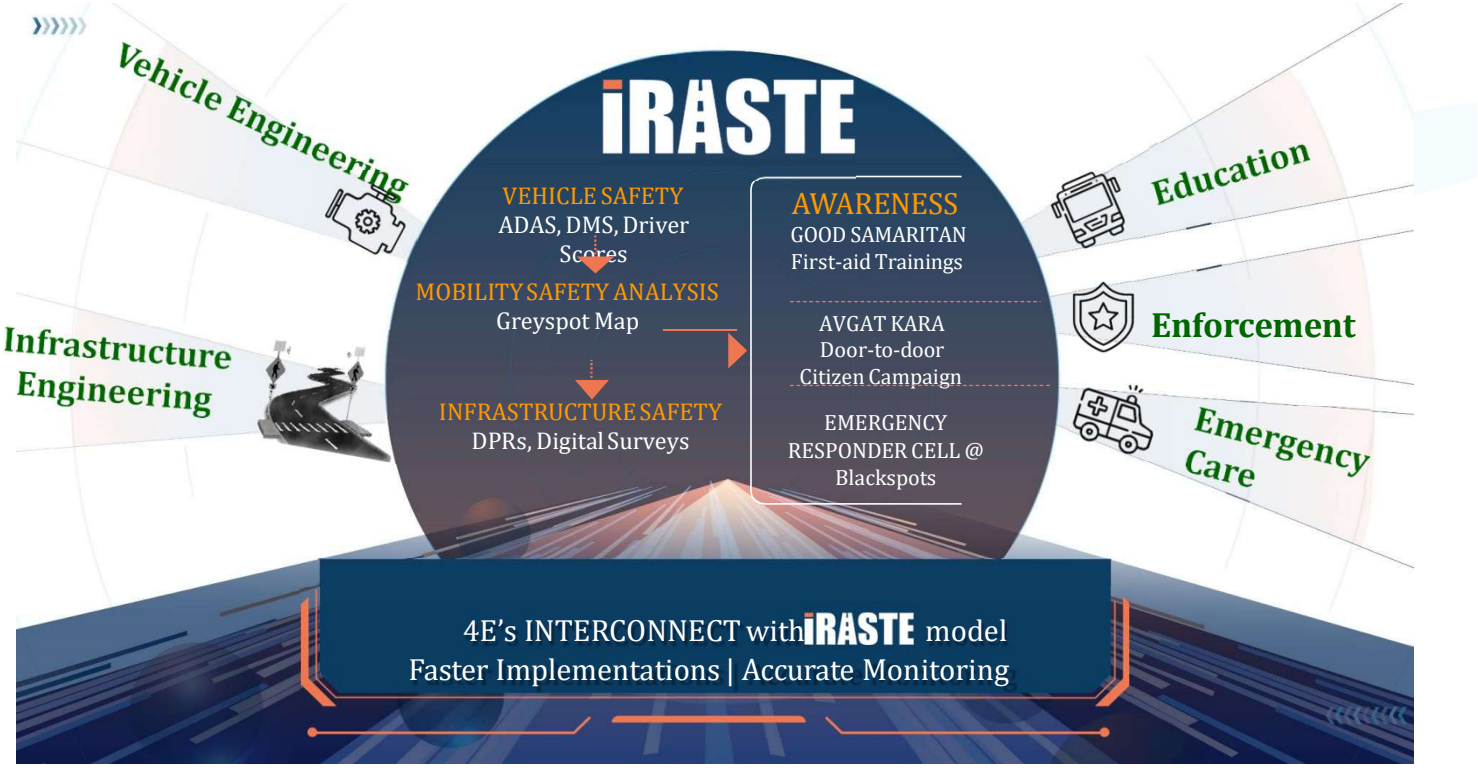
https://www.who.int/teams/social-determinants-of-health/safety-and-mobility/decade-of-action-for-road-safety-2021-2030

About Project iRASTE: A Pilot Study

Achievement of Global Plan is possible through-

Goal:

Implementation of a holistic Safe Systems Approach for **up to 50 % reduction in road crashes** by leveraging AI.



Deployment of AI-Powered Advanced Driver Assistance System *(ADAS)* to tackle Road Safety

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*Research has shown that driver alerts provided up to **2 seconds prior** to a risky situation can be life-saving*

ADAS* Safety Alerts to Driver

Forward Collision Warning (FCW)
Improves driver alertness to **forward collision** events

Pedestrian Collision Warning (PCW)
Improves driver alertness to **vulnerable** road users

Headway Monitoring & Warning (HMW)
Helps driver **maintain safe distance** from the vehicle ahead

Lane Departure Warning (LDW)
Promotes lane discipline *(use **turn indicator before changing lanes**)*

Vehicle Safety

ADAS + Driver Trainings

Camera focused on road

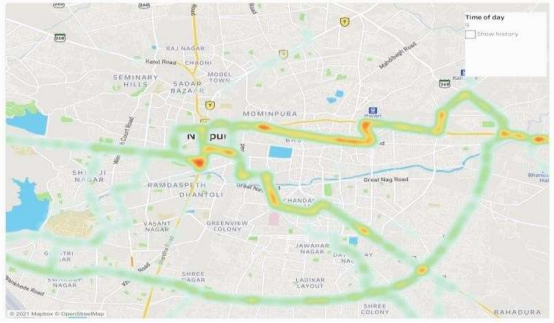
Display unit *(audio + visual alerts)*

Infrastructure Safety

Blackspots Improvement Plan

Mobility Analysis

Greyspot Map



Social Awareness

City Wide Campaigns

Vehicle Safety: Improve safety of Buses through achieving safe driving behaviors by deploying ADAS

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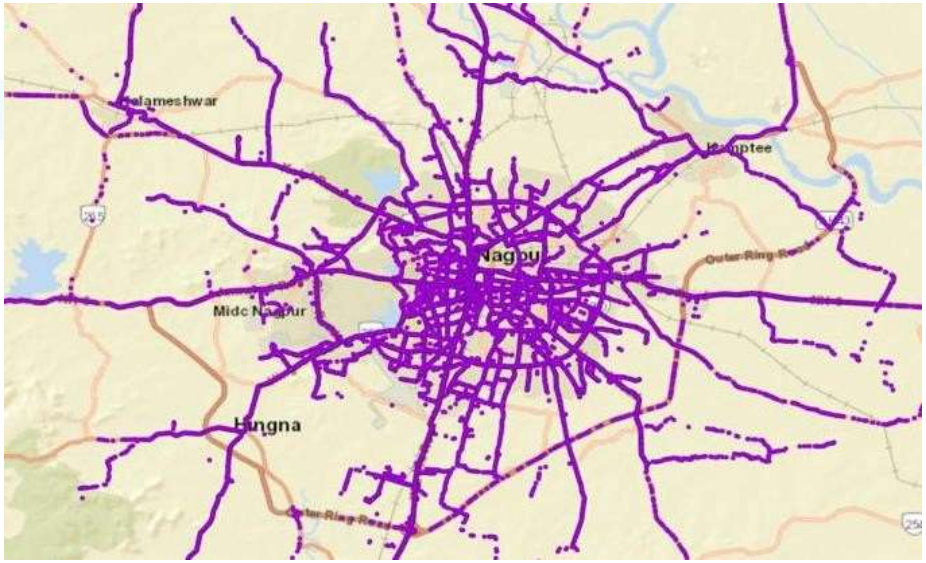
AI-based safety technology: A new approach to driver skilling

Coverage of ADAS Bus Fleets in Nagpur city



- Project: iRASTE is now India's largest and longest running study on ADAS for commercial vehicles.
- Additionally, operator risk score is tracked monthly and there has been a 31 % reduction in risk score since the start of the study. This represents a major upgrade in driver skilling.
- 1337 drivers of Nagpur Municipal Corporation *(NMC)* including school bus drivers were trained on Defensive Driving coupled with the features of ADAS.
- 207 safety champions were awarded for adherence to ADAS alerts.

Summary of Driver Safety Performance of Nagpur Municipal Corporation (NMC) Bus Fleets

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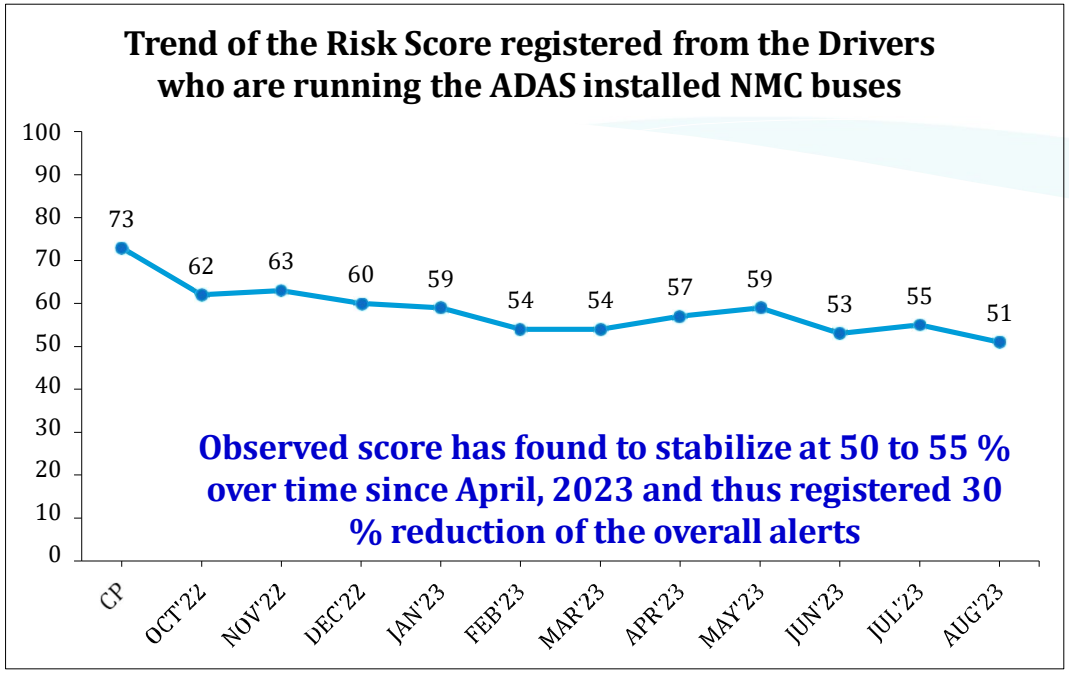

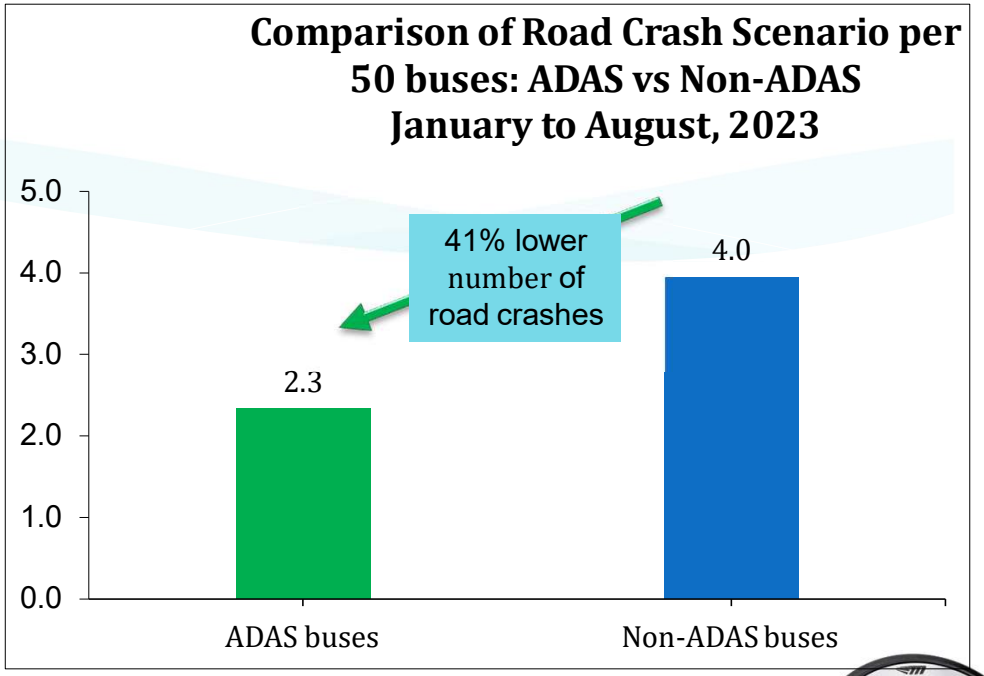

- **Road Crash rates in ADAS buses has registered 41 % decline since its full-scale deployment in 2023 covering 200 ADAS buses as compared to 250 non-ADAS buses.**

*ADAS: Driver display unit of ADAS safety device →

Mobility Safety: Proactive identification of probable road crash prone locations, *i.e. termed as Greyspots*

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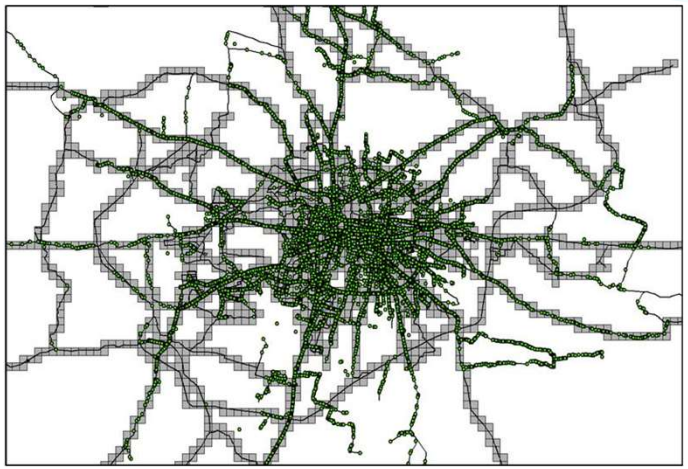
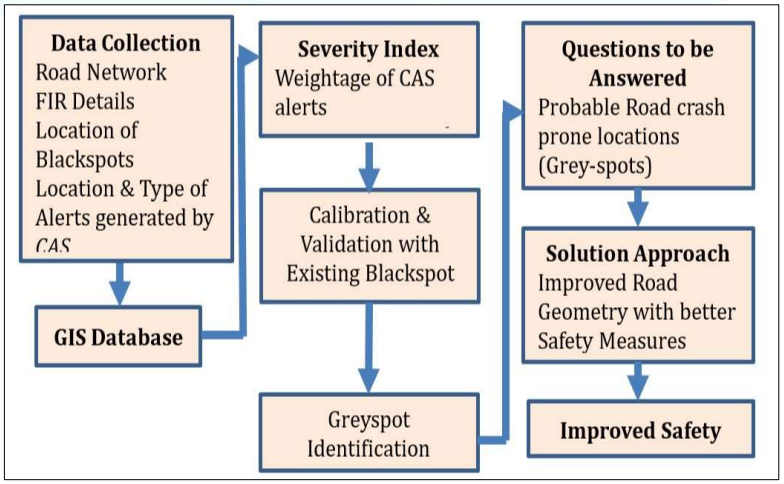
GREYSPOTS:

Identification of locations on road network, which have a potential to become Blackspots in the foreseeable future, if no corrective road safety measures are taken at these locations to prevent road crashes

ADAS devices installed in NMC Bus Fleets



Alerts generated from vehicles with ADAS devices



Study Methodology

Accurate and more scalable than manual surveys

Model for Greyspot Identification

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1. Intersection model: Can be Used in Identifying the Greyspots at the intersections area.

Severity Index *(SI)* = 1.03*n3arms + 0.814*n4arms + 2.281*nSumRoads + 1.34*nFCWspeed + 1.27*nPCWspeed

AICc Value 236

Static variables

Dynamic variables

2. Midblock model: Used in Identifying the most unsafe corridors

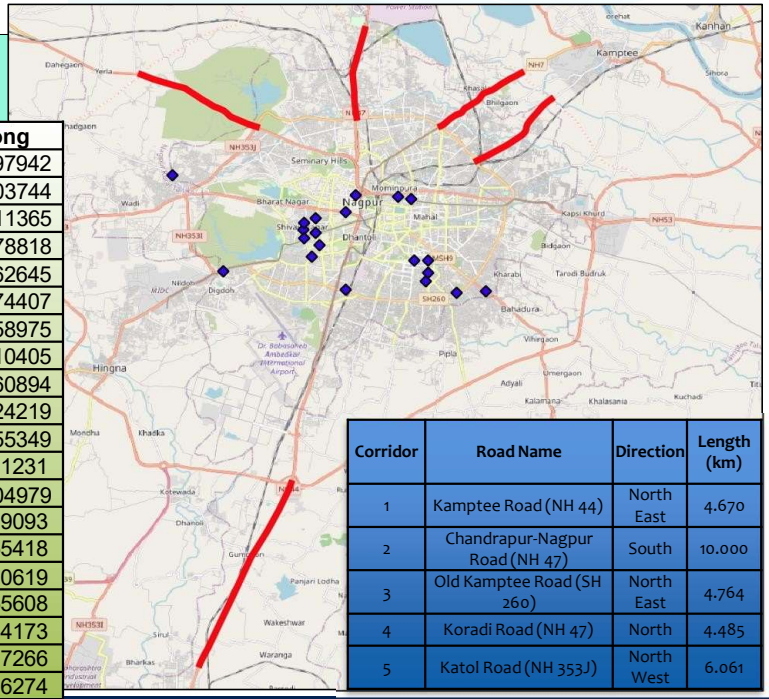
Severity Index *(SI)* = -93.567*TimeGap (b/w alerts) + 79.574*Speed (b/w alerts) +3.680*RoadWidth

Greyspots and Top 5 most unsafe corridors identified *(from Quarter 1 2 and 3 data in 2023)*:

Greyspot Map: Potential future Black spots

- ❑ New AI-based data approach to predict Potential Black spots, Current Black spots, & Improved spots
- ❑ Accurate, automated and more scalable than manual surveys
- ❑ Enables precise & prompt interventions in Enforcement and Emergency Care

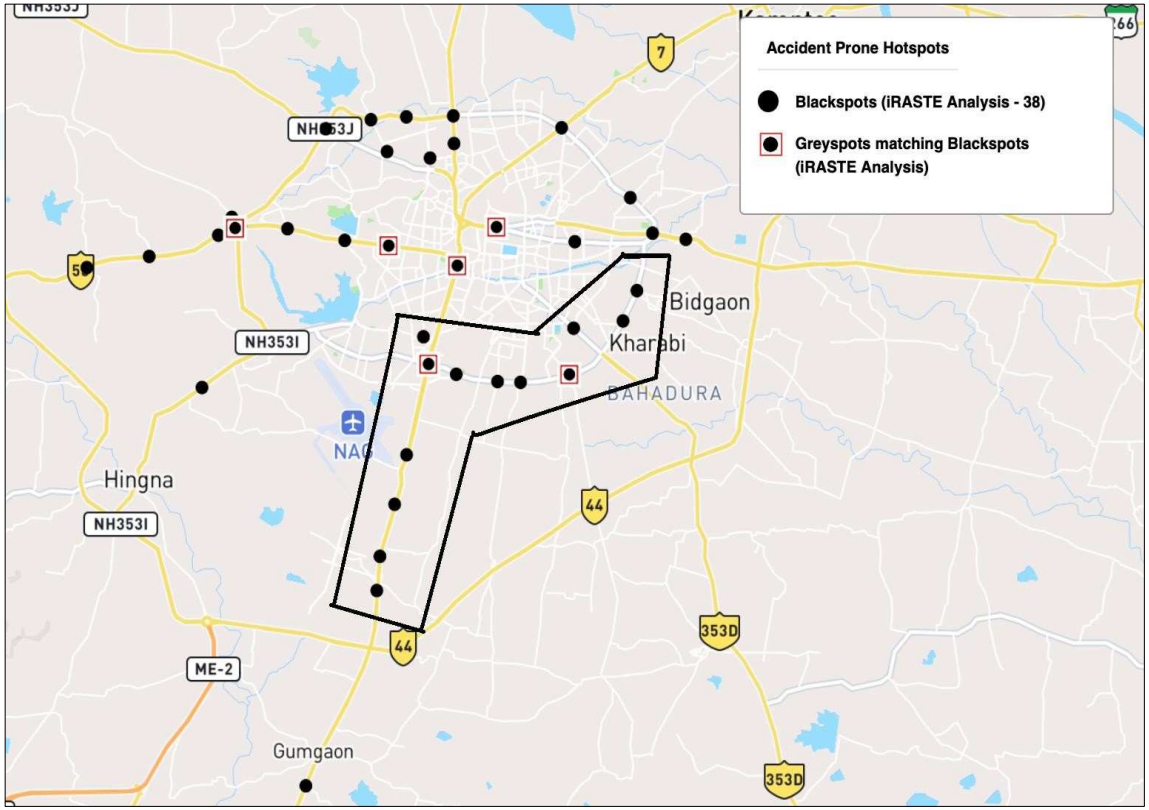
S. No.	Location name	lat	Long
1	Gitanjali Square	21.152096	79.097942
2	Agrasen Square	21.150943	79.103744
3	Raghuji Nagar (Chota tajbagh chowk)	21.123422	79.111365
4	RBI Square 21.152658		79.078818
5	Bajaj nagar square	21.130229	79.062645
6	Bardi, Civil lines (Maharajbagh chowk)	21.145244	79.074407
7	Sir visweswarraya square	21.124952	79.058975
8	Shishu mandir school, old kailash nagar	21.113882	79.110405
9	Coffee house intersection	21.142358	79.060894
10	Powerhouse chowk	21.108898	79.124219
11	Shivaji Nagar (Ramnagar chowk)	21.137011	79.055349
12	Ayodhaya Nagar Square	21.117775	79.111231
13	Tukdoji Putla Square	21.12335	79.104979
14	Bhagat Square	21.118545	79.019093
15	Ram nagar to Chota ram nagar	21.140332	79.055418
16	Shankar nagar square	21.135921	79.060619
17	Gandhi nagar square	21.133362	79.055608
18	Chatrapati Hall, Somalwada	21.110287	79.074173
19	Atul Lawn, Dighori	21.109586	79.137266
20	Khadgaon Road Gajanan Mandir	21.161838	78.996274



Corridor	Road Name	Direction	Length (km)
1	Kamptee Road (NH 44)	North East	4.670
2	Chandrapur-Nagpur Road (NH 47)	South	10.000
3	Old Kamptee Road (SH 260)	North East	4.764
4	Koradi Road (NH 47)	North	4.485
5	Katol Road (NH 353J)	North West	6.061

Infrastructure Safety: Improvement of the Blackspots

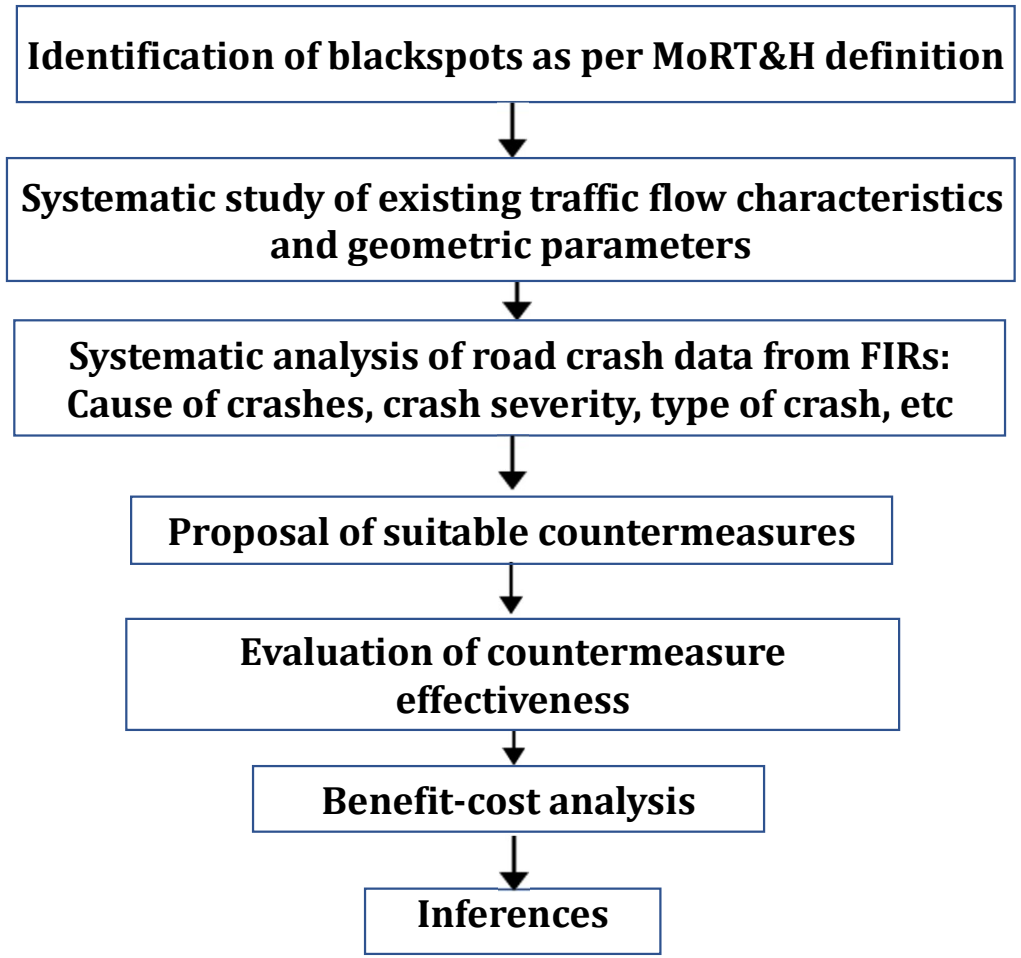
- Analyzed 117 listed spots from all sources & identified **38 Blackspots.**
- Detailed Project Report ***(DPRs)*** for all the 38 locations were prepared and submitted in September 2022 to the five stakeholders who are manning the Nagpur Metropolitan Region namely, *NHAI, NMC, PWD -SR, PWD-NHAI, PWD-WB)*
  - ➢ 8 Blackspots were identified on priority for implementation of some of the remedial measures.
  - ➢ 20 % to 40 % speed reduction were observed with the implementation of Transverse Bar Markings *(TBMs)* **Wadhamna Intersection Blackspot**.
- **Economic - Benefit Cost Assessment** was done for 4 locations; Estimates show that **66 % reduction in road crashes & 40 % reduction in fatalities** can be achieved if all the recommended measures are implemented.



Focus Area for Blackspot Improvement & Awareness Programs

Economic Benefit Assessment of Black Spot Improvements

Methodology:



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Benefits of Black Spot Treatment

- The proposed countermeasures were found to be cost effective for the four blackspots conforming to IRC: SP-131 *(2022)*.
- About 60 to 66 percent reduction in the overall road crashes coupled with 40 % reduction in fatalities if the countermeasures are implemented.
- Economic Internal Rate of Return *(EIRR)* was found to be ranging between 54 % - 66 % through the analysis period of 5 years **- A significant return on investment *(ROI)*.**
- Even the First Year Rate of Return *(FYRR)* was estimated to be ranging between 1.42 % - 2.76 %, **which shows that there is bound to be an immediate ROI.**

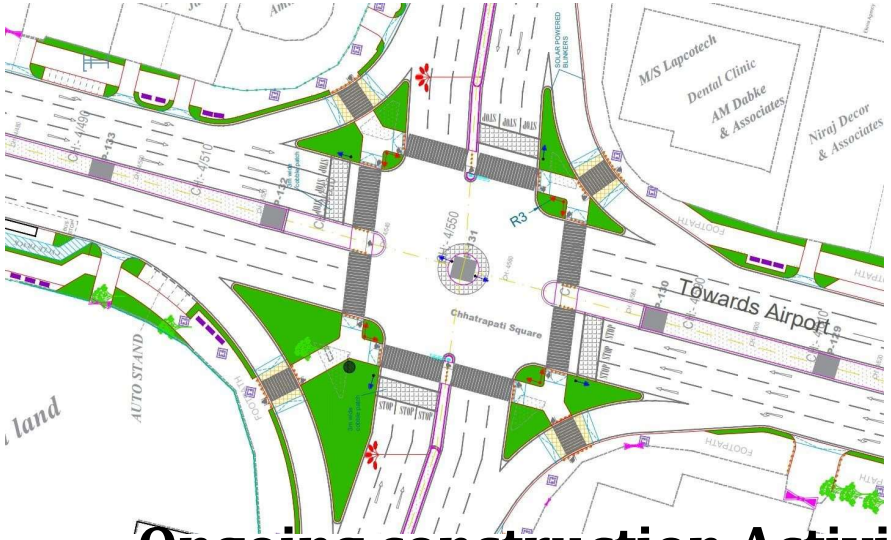
01.0 Study Area: Chattrapathi Shivaji Square

Bird's Eye View

Ground View Before Implementation

01.0 Chattrapathi Shivaji Square (Contd…)

A Glimpse of the Design



Ongoing construction Activities as per the Design

01.0 Chattrapathi Shivaji Square (Contd...)

Before:

After:

- We have been able to reclaim the residual spaces and reducing the pedestrian crossing distance and larger channelizers for vehicles also elongated traffic islands for traffic control.
- Extended the dividers for easier traffic movement at the junction.
- We reclaimed the extra spaces on the sides of the road and turned them into organized parking, cycle track, wider footpaths and green spaces etc.
- **Construction of Table top for safer movement of Pedestrians at the Free Left Turns are under progress.**

02.0 Study Area: Ajni Square

Bird's Eye View

Ground View Before Implementation

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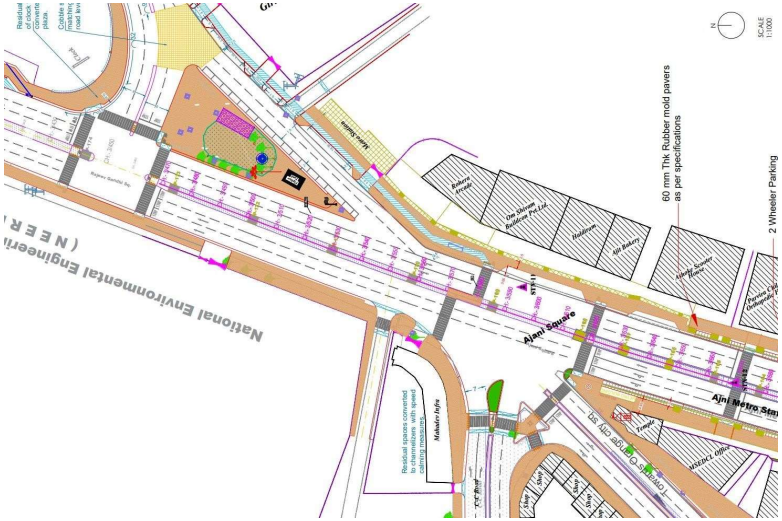
02.0 Ajni Square (Contd...)

A Glimpse of the Design



Ongoing construction Activities as per the Design

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02.0 Ajni Square (Contd...)

Before:

Improper traffic and pedestrian movements

- We have been able to reclaim the residual spaces and reducing the pedestrian crossing distance and larger channelizers for vehicles.
- Also Introducing traffic islands for traffic controls.
- We have introduced table top slip lanes for safer left turns. Introducing dividers for easier traffic movement at the junction.
- We reclaimed the extra spaces on the sides of the road and turned them into organized parking, cycle track, wider footpaths, green spaces and public sitting spaces with proper lightings.
- **Construction of Table top for safer movement of Pedestrians at the Free Left Turns are under progress.**

After:

Regulated traffic movement

Provision of Footpath coupled with restoration of Rest Space which is provided at about 200 m away from the intersection

03.0 Study Area: Jaiprakash Nagar Square

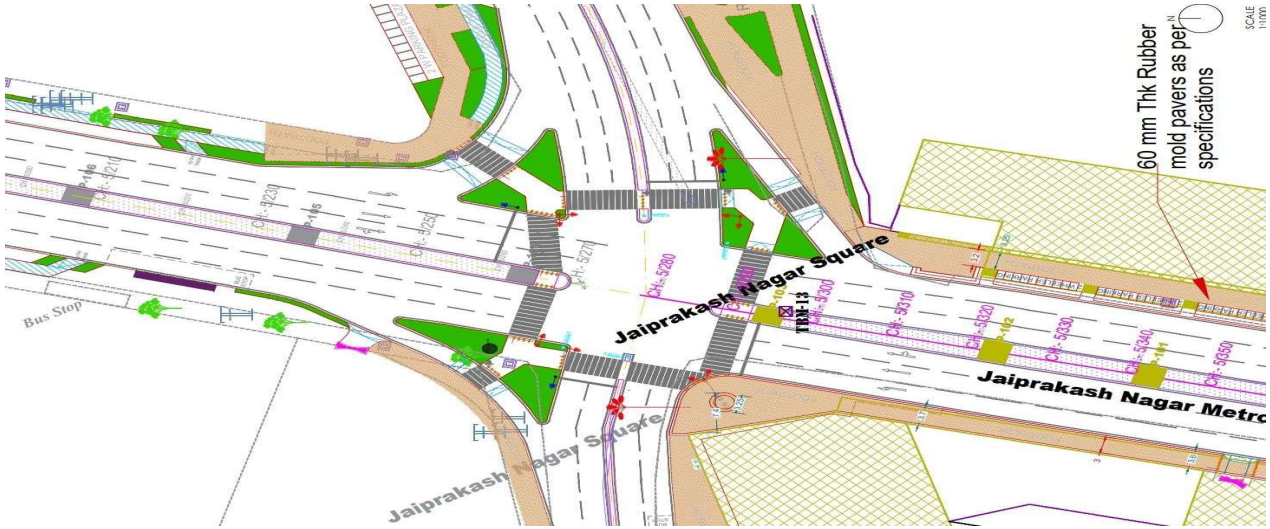
Bird's Eye View

Ground View Before Implementation

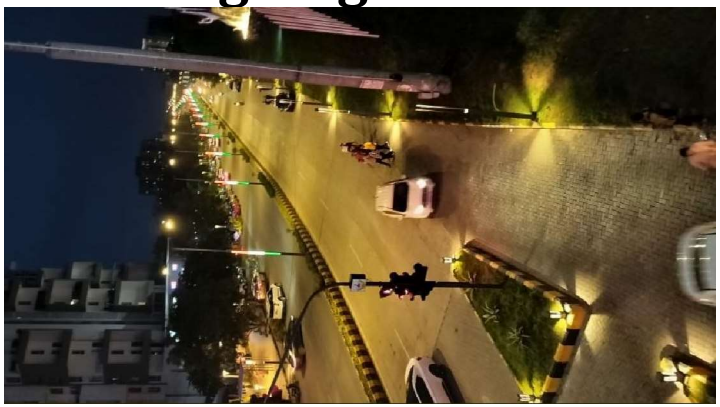
Project iRASTE

03.0 Jaiprakash Nagar Square (Contd...)

A Glimpse of the Design



Ongoing construction Activities as per the Design



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03.0 Jaiprakash Nagar Square (Contd...)

Before:

Improper traffic and pedestrian movements

- We have been able to reclaim the residual spaces and reducing the pedestrian crossing distance and larger channelizers for vehicles.
- Provide speed calming premises and road signs and manuals.
- Re oriented the dividers for easier traffic movement at the junction.
- We reclaimed the extra spaces on the sides of the road and turned them into organized parking, cycle track, wider footpaths and green spaces etc.
- Provided minimum of 40 Lux of Street lighting illumination and recreate public spaces.
- **Construction of Table top for safer movement of Pedestrians at the Free Left Turns are under progress.**

After:

Proper traffic movement

Proper Pedestrian movement

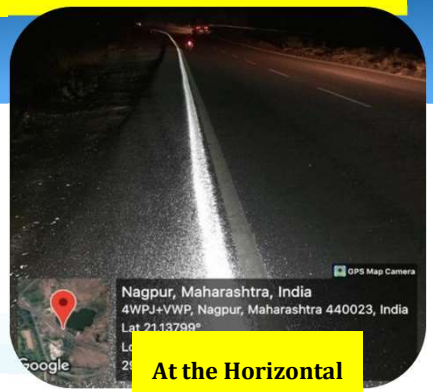
4.0 Nagpur-Amravati National Highway *(NH 53)*: Safety Interventions

Near Wadhamna Intersection: 6 fatalities, 9 Injuries, and 18 Crashes during the last 4 years from 1.1.2019: Hence identified as a Blackspot

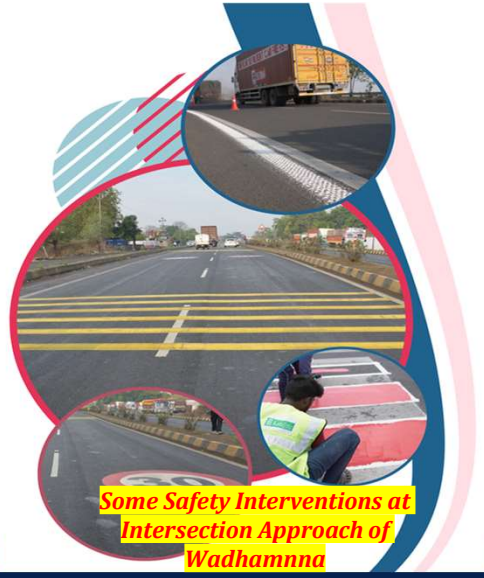
Wadhamna Intersection at NH-53, Amravati Rd: Listed as a Black Spot

Horizontal Curved section, 900 m away from the Wadhamna Intersection @ NH 53 @ Surabardi.

Hazard Markings At the Intersection Approach



At the Horizontal Curved Section



Some Safety Interventions at Intersection Approach of Wadhamnna

Post application of safety measures at Waddhammna Intersection

AWRD (Augmented Wet Reflective Dot Marking System) at the Curve of 270 m radius

Transverse Bar Marking (TBM) Specification

No. of Strips per set	Thickness	Location from Hazardous zone *(intersection)*
6	5 mm	180 m
6	10 mm	120 m
6	15 mm	80 m
6	20 mm	50 m
9	20 mm	25 m

Social Awareness

Avagat Kara: 30-day comprehensive public awareness program of 500 people in a locality assembled; Each participant took an oath to follow the traffic rules every day & to correct human errors. The program is expected to positive changes in terms of improving their driving behavior near Blackspot / Greyspot Locations.

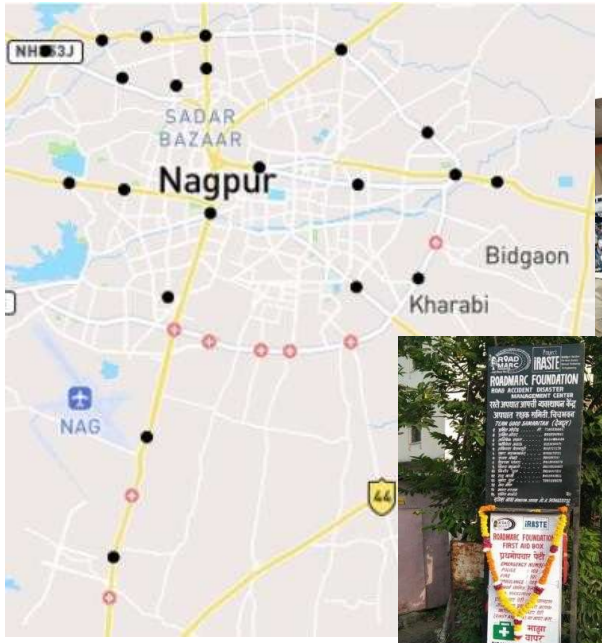
First Aid Training: Traffic Police Station led community First Aid Training programs to train citizens in basic First Aid to assist accident victims.

Date	Location
17/5/2023	M.I.D.C POLICE STATION
20/5/2023	SONEGAON POLICE STATION
22/5/2023	MAHINDRA & MAHINDRA
24/5/2023	KAMTHI POLICE STATION
25/5/2023	AJNI POLICE STATION
25/5/2023	BALTARODI POLICE STATION
28/5/2023	JANKI NAGAR MAHILA MANDAL

Good Samaritan Event: Held successfully on 10th July 2023 with the participation of 2000 attendees from various segments of society. All of them were trained on first aid and took an oath to follow traffic rules.

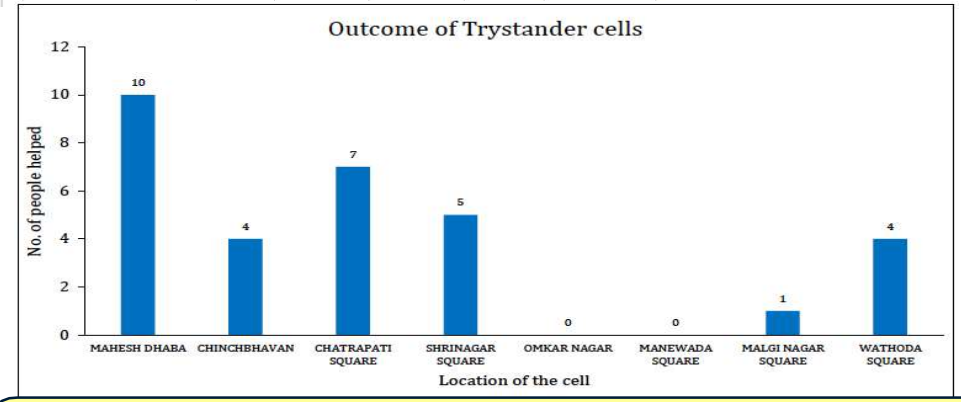
Trystander Cells: Emergency Care

- **Trystander Cells installed in 8 Blackspot Locations**
- Each Cell has a First Aid Box and list of Volunteers *(10-15)* who can be called for Emergency Care.
- All Volunteers trained on how to handle Emergency situation during Golden Hour Situations



Trystander Cells - Outcome

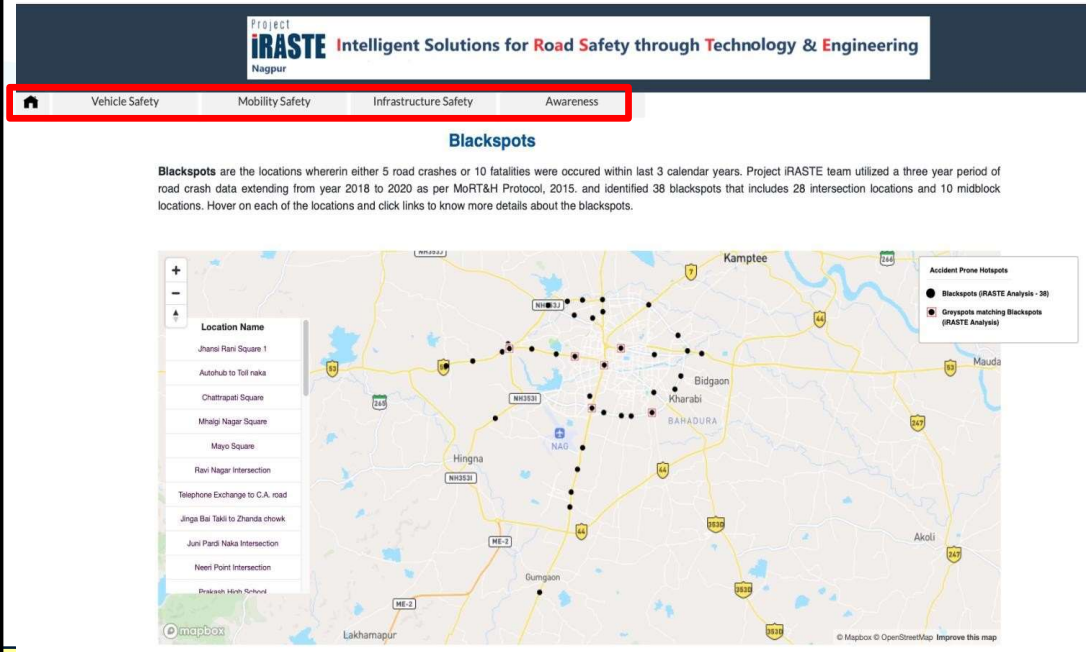
No	Blackspot Location	DATE OF OPENING	No of People who attended the Inaguration	No of people Registered for screening	No of Good Samaritans who are available to help	No of Accident victims helped	Type of Help provided
1	MAHESH DHABA	22-Jul-23	62	206	13	10	Major Accident provided First Aid & Admitted to Hospital
2	CHINCHBHAVAN	10-Aug-23	77	152	15	4	Major Accident provided First Aid & Admitted to Hospital
3	CHATRAPATI SQUARE	28-Aug-23	55	272	17	7	Minor Accidents Provided First Aid Only.
4	SHRINAGAR SQUARE	28-Nov-23	58	280	14	5	3 Minor Accidents And 2 Major Accidents where Admitted to Hospital
5	OMKAR NAGAR	10-Nov-23	73	230	15	0	
6	MANEWADA SQUARE	24-Nov-23	78	280	14	0	
7	MAHALGII NAGAR SQUARE	10-Nov-23	82	250	17	1	
8	WATHODA SQUARE	05-Nov-23	68	180	13	4	Minor Accidents Provided First Aid . And One was Admitted to Hospital



Since Aug 2023, Trystander Cells in these 8 Blackspot Locations have attended to **31 road crash victims which happened in the vicinity of the identified Black Spots / Gret Spots of Nagpur roads**.

Project iRASTE Dashboard

https://inaix.iiit.ac.in/nagpur-iraste/dashboard



Overall Summary of iRASTE: Nagpur and Way Forward

- **Vehicle Safety:**
  - ✓ **250** vehicles are equipped with CAS devices, 1100 drivers trained in Defensive driving & ADAS.
  - ✓ **90 %** of drivers in ADAS-enabled buses have shown sustained improvement in safe driving behavior.
  - ✓ **31 %** reduction in road crashes observed in the lead operator *(Hansa Travels)*
- **Mobility Analysis:**
  - ❑ Identified 19 Greyspots *(Potential future blackspots)* based on AI & data insights
  - ❑ Meeting with DCP Traffic, sensitizing them for enhancement
  - ❑ Road Quality Index - Defined and validated for one pilot corridor
- **Infrastructure Safety:**
  - ✓ All 38 DPRs submitted in September, 2022 and round table chaired by Commissioner, NMC was held in June, 2023
  - ✓ Before and After Videos for 2 spots, Economic Impact Assessments for 4 spots for showcasing to stakeholders
  - ✓ Implementation of the remedial measures are in progress at 3 locations plus partial implementation at Waddhammna Intersection
- **Awareness:**
  - ✓ Eye camp & spectacle distribution conducted for 600 NMC drivers
  - ✓ Completed Pilot awareness programs at Greyspot and Blackspot.
  - ✓ Initiated Sustained Social Media Campaign
- **iRASTE: Telangana**
  - ✓ 150 plus buses ADAS equipped + 10 buses DMS equipped: **Monitoring under progress**
  - ✓ Two driver training programs completed
  - ✓ Focus on insights for driving behaviour on highways & ADAS + Driver Monitoring System *(DMS)* based insights for "near miss road crashes"
- **Together, iRASTE: *(Nagpur + Telangana)* is now India's largest study of ADAS for commercial vehicles (~ 350 Buses covering Public & School Fleets)**

Project iRASTE

Thank You

Project iRASTE

Intelligent Solutions for Road Safety through Technology & Engineering

A Mission to Reimagine Road Safety with the Predictive Power of AI