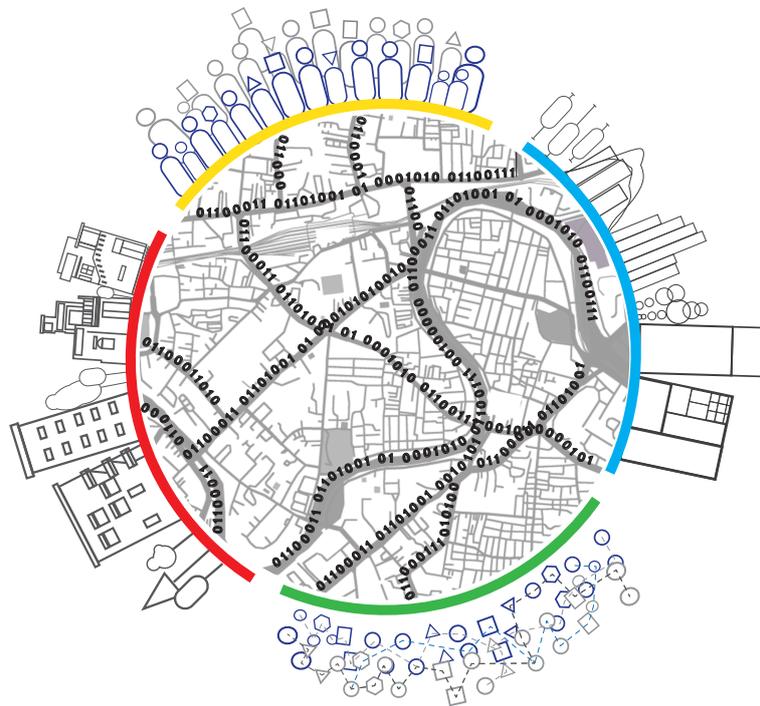


# Smart Solutions to Overcome Traffic Congestion

Intelligent Traffic Management System in Jabalpur

CASE STUDY 9 | MARCH 2021



POWERED BY

TATA TRUSTS

Data Driven Governance

URBAN  
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Ministry of Housing and Urban Affairs' Smart City Mission was launched on 25 June, 2015. The main objective of the mission is to promote cities that provide core infrastructure, clean and sustainable environment and a decent quality of life to their citizens through the application of 'smart solutions'. The mission aims to drive economic growth and improve quality of life through comprehensive work on social, economic, physical and institutional pillars of the city. The focus is on sustainable and inclusive development by creation of replicable models which act as lighthouses for other aspiring cities.

100 cities have been selected to be developed as Smart Cities through a two stage competitive process. In the context of our country, the six fundamental principles on which the concept of Smart Cities is based are (i) Community at the core of planning and implementation; (ii) Ability to generate greater outcomes with the use of lesser resources; (iii) Cooperative and competitive federalism; (iv) Integration, innovation and sustainability; (v) Technology as means, not goal; and (vi) Sectoral and financial convergence.

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Data Driven Governance

**URBAN**  
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# **Smart Solutions to Overcome Traffic Congestion**

Intelligent Traffic Management System in Jabalpur

**TATA TRUSTS**

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# CONTEXT

**Keywords:** City Data Officer, Smart Cities, Urban Local Bodies, ITMS, traffic management, e-challan, road congestion

In 2016, Jabalpur became one of the 100 smart cities of the Smart City Mission by Ministry of Housing & Urban Affairs (MoHUA). Under the Smart City Mission, the city has pioneered several initiatives to improve urban mobility. The said initiatives include:

- **Public Bike Sharing** – Promotes use of bicycle and provides an alternative low cost environmental friendly mobility option to city residents.
- **Intelligent Traffic Management System-** Leverages information communication technology at all junctions in Jabalpur to improve traffic management.
- **Smart Parking-** Use of information technology to improve parking operations, optimize usage of the available parking supply, and improve the overall functionality of the streets.
- **Charging facility for E-Rickshaws.**
- **J Card-** A radio frequency identification (RFID) based multi-purpose mobility card for the city of Jabalpur.
- **Chalo App-** Provides real time transit, bus location tracking, and route mapping.

This case study focuses on Intelligent Traffic Management System (ITMS) and details how

the implementation of ITMS has helped the city to reduce its road congestion and traffic rules violation. By introducing mechanisms for collection of real time data, making the data collected accessible for analysis, coordinating with other urban local body departments, the city has been able to address mobility management related challenges.

Tata Trusts, through their Data Driven Governance (DDG) portfolio have been working towards enabling stakeholders within a governance system to view & leverage data as a cornerstone for decision making. Trusts collaborated with the Ministry of Housing & Urban Affairs (MoHUA) to implement a capacity building [course](#) for City Data Officers (CDOs) and urban local body officials across the 100 smart cities.

The course aims to support and enable civic officials in the adoption of evidence based decision making in day to day city planning and administration. The course focuses on an urban data governance framework that can be applied in achieving key city objectives, driving effective policy decisions and improving transparency. It includes topics such as, change management, tools and techniques for data gathering, cleaning, analysis, visualization, performance benchmarking, urban data policies, data governance & regulatory framework, urban data platforms, using data for policy to name a few.

# Smart Solutions to Traffic Management

## The Challenge

Jabalpur is the largest city in the Mahakaushal region of Madhya Pradesh. It is the regional hub of government, judiciary, defense, railways, education, tourism, medical centers and primary markets. It is home to several state and national government establishments such as, the principal seat of Madhya Pradesh state high court, defense headquarters for Bihar, Odisha, and Madhya Pradesh, headquarter for the West Central Zone of Indian Railways. It houses military motor vehicle factory bases such as Vehicle Factory Jabalpur, Grey Iron Foundry, and Gun Carriage Factory. These factories manufacture various products for the Indian Armed Forces. It functions as a [regional distribution](#) center for agriculture and allied activities.

In the recent past, Jabalpur has witnessed increased urbanization due to many factors such as better employment opportunities, higher standards of living, good education and health facilities. In Madhya Pradesh, Jabalpur is the [third most populated](#) urban agglomeration, after Indore and Bhopal. As per [census 2011](#), the population of Jabalpur district is 24.60 lakh of which 10.54 lakh individuals live in Jabalpur city. With increase in

population, the city witnessed a rise in number of vehicles on the roads and subsequently increased traffic on the roads. The city also saw a rise in instances of non-adherence to traffic rules, consequently traffic safety also became a concern. Following challenges were identified:

- Road congestion due to on-street parking
- Need for reliability on transport network
- Smooth operation of traffic interrupted by uncontrolled intersections
- Utilization of road network below capacity
- Huge number of speeding vehicles
- Lack of traffic or transit technology to improve the usability of roads<sup>1</sup>
- Inadequate road network systems through peripheral areas of the city

While increased urbanization can be a catalyst for economic growth, it also warrants targeted city planning to ward off added pressure on the existing infrastructure. Keeping this in mind, Jabalpur introduced the Intelligent Traffic Management System.

The state government of Madhya Pradesh has been very vigilant of the increasing urbanization in the state and has supported numerous infrastructure projects such as ITMS in Jabalpur.

It relies on information through data collection from various junctions for efficient and informed decision making. Jabalpur is one of the pioneer cities in Madhya Pradesh to implement ITMS.

# The Solution

## A. Proposed Solution

In 2018, Jabalpur Smart City collaborated with the Police Department Jabalpur to plan, develop and implement a reliable, information technology enabled Intelligent Traffic Management System (ITMS) at major road junctions of the city. ITMS employs technology to improve traffic management, reduce road congestion and create a good road experience for the commuters.

## B. How was it implemented?

Jabalpur Smart City signed an MOU with Police Department Jabalpur and Transport Department Jabalpur<sup>2</sup>. Delhi Integrated Multi Modal Transit System (DIMTS) was on boarded as the system integrator. DIMTS created a detailed project report (DPR) which surveyed and identified the critical areas where traffic congestion was a problem.

On the basis of this report, the sites of implementation were identified. 12 junctions were identified for installation of traffic signals. The installation was done in a phased manner on the basis of traffic density.

3

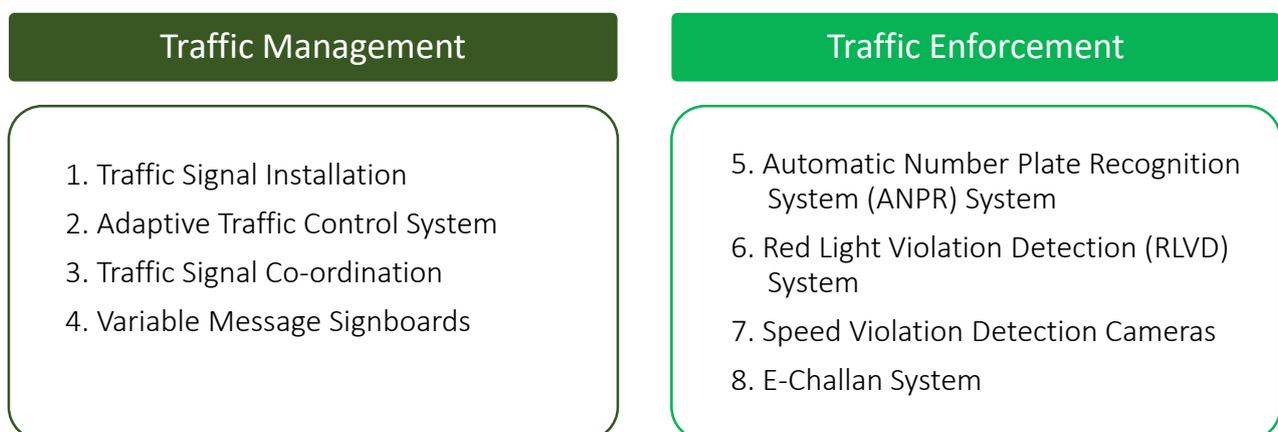
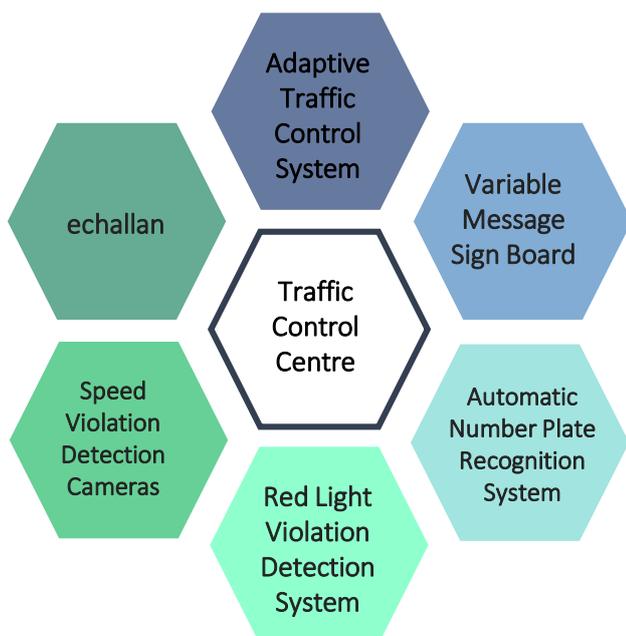


Figure 1: Project Components & Solutions

- **Phase1:** High priority (*commercial intersections, connectivity to major activity areas*).
- **Phase2:** Medium priority (*semi commercial intersections*).
- **Phase3:** Low priority (*residential and secondary road networks*).

Within the Integrated Command and Control Center (ICCC)<sup>3</sup>, a state of the art Traffic Control Center (TCC) was created. All the data collected through automated sources of ITMS is collected, stored, and processed at TCC. TCC provides the refined data to ICCC.



**Figure 2: Components of the TCC**

### ***B.1 Adaptive Traffic Control System***

At every traffic signal, a vehicle detection camera is deployed that detects the real time traffic flow. On the basis of the traffic flow, signal timings can be controlled through the TCC to manage road congestion.

Real time status of each junction is available at the control room 24 x7. Signal timings can be managed in the best possible combination of manual, pre-fixed and automated.

### ***B.2 Variable Message Signboards (VMS)***

VMS are digital road signs used to inform commuters about specific events and real-time traffic conditions. It is an effective way of informing commuters about traffic congestion, accidents, incidents, roadwork zones, or speed limits.

VMS is usually installed at locations where there are alternate roads for traffic movement; high density of traffic; connection to major activity areas; bottle neck points. This will be implemented in its entirety at a later stage.

Currently, it has been installed at a few traffic signals and is being used as public information system for running social messages, traffic rules, commercials advertisements etc. VMS is integrated with TCC from where the messages displayed are controlled.

### ***B.3 Automatic Number Plate Recognition System (ANPR)***

ANPR cameras can identify vehicles by reading the number plates on vehicles. The vehicles are identified by matching it with the data which is extracted from Regional Transport Office (RTO)<sup>4</sup> using application programming interface (API)<sup>5</sup>. A software by Vehant Technologies is used for matching the ANPR camera data with RTO database.

ANPR has been installed in locations with parking restrictions, intersections leading to major activity centers, major activity centers, commercial areas, areas with higher instances of wrong side movement<sup>6</sup>.

### ***B.4. Red Light Violation Detection (RLVD) System***

RLVD uses over view cameras to capture images and videos of violations events such as crossing on red light, over driving the stop line etc. If a red light malfunctions, cameras become dysfunctional or misaligned, RLVD system generates an alarm at the TCC.

It has been installed<sup>7</sup> at activity centers, intersections with schools, hospitals, locations with increased traffic light violation, and locations with increased instances of speeding.

### ***B.5 Speed Violation Detection Camera (SVD) System***

Speed violation detection camera system detects speed violations by capturing the speed and image of each vehicle.

It can capture multiple infracting vehicles simultaneously with data on type of violation; speed of violating vehicle; notified speed limit; date, time, and location. The data is transferred to the TCC in real time for verification of the infraction and processing of challan.

Speed violation cameras have been installed at locations with high incidents of speeding. These include wider roads with free flowing traffic, intersections or streets leading to streets with lower densities, wide roads where it's easier to accelerate, locations with schools, hospitals, institutional and commercial areas<sup>8</sup>.

### ***B.6. E-Challan System***

E-challan system is configured to automatically generate traffic challans based on infractions received from field through RLVD, ANPR, SVD etc. after the violations are duly checked by the operator at TCC. Analytical data for e- challans is prepared by Mota Data Software<sup>9</sup>.

The e-challan system allows to leverage technology to improve traffic management efficiency; brings transparency in challan issuance system; detects repeats offenders for issuance of higher fines for

violations of same traffic rules; maintains database of challans issued and carries out analysis for informed decision making for traffic violations in specific locations.

System Integrator keeps the TCC functional 24x7. When a violation alert is received at the TCC, the occurrence of the event is validated by the technical operator. Reason behind this is that the accuracy of the data captured by the system is 85% at day and 75% at night. Inaccuracy stems from license plates which are manually written, have unstandardized fonts (e.g. sometimes the camera reads '5' as 's' given the similarity of the symbol)<sup>10</sup>. Once the violation is verified, challan is issued. Police Department has deployed an Assistant Sub Inspector of Police at the TCC who validates the challan.

The citizen is notified of the challan through a message on the phone which contains a pdf file detailing the type of violation along with evidence. With the cooperation of the post office, challan is delivered to the offender<sup>11</sup>. The challan can either be paid online or offline. The most common types of challan are generated for - triple riding, no helmet challan, over speeding challans.

DITMS is responsible for on field survey, installation, connectivity, electricity, operator, challan printing and dispatch is taken care of by the vendor. Eventual ownership of data lies with Jabalpur Smart City.

## C. Solution Enablers

### Cross Departmental Coordination

- Support of the police department, specifically deployment of a dedicated Assistant Sub Inspector to validate the challans.
- Support of the municipal cooperation for infrastructure instalment
- TCC data structure is compatible with Jabalpur Police database structure

### Data Management

- Violation data which is sorted by date, time, location and vehicle registration number, making it easy to comprehend and utilize and analyze it further.
- The system records videos and photos of violations. This provides evidence in case challan is contested by the offender

### Connectivity

- Laying a fiber optic network allows for uninterrupted connectivity, reduces dependencies on third party suppliers and reduces regular lease line cost per month

## D. Challenges

### Inconsistencies in Data

- Duplicates in the receipt number (manual process) generated for offline payment of challans by the individuals.
- Data relating to names, phone numbers, and addresses of individuals is exported from RTO database. Often the RTO database is not updated resulting in non-delivery of challans.

### Unpaid Challans

- Not all challans are paid by violators. Many remain unpaid. Between January & December 2020, the sum of paid challans was INR 49 Lakhs, in contrast, the sum of unpaid challans was INR 1.17 Crores. This includes 3-4 months of Covid-19 lockdown period during which no challans were generated

### Challan Delivery

- The postal department has the capacity to deliver specific numbers of challans on a given day resulting in delayed delivery.
- Motor vehicle Act mandates the delivery of challans in hard copies as a result challans can't be sent digitally through phone messages or emails.

### Cross Departmental Synergies

- No common database for all different departments involved
- A lot of installation had to be done at night to avoid traffic during the day

### Revenue Generation

- Currently, the revenue generated through ITMS is not allotted to the Smart City. Going forward, revenue sharing will be crucial for a self-sustainable model.

## The Impact

7

### Improved Traffic Management

- Implementation of ITMS has improved overall traffic management by reducing congestion on the roads.
- Repeat offenders can be identified allowing for the possibility of higher fines for repeat offenders. In case of nonpayment by repeat offender the case is submitted to court for resolution. In 2019, there were 19916 repeat offenders who did not pay challans, in 2020- 4524 and in 2021 (till January)- 134
- Increased awareness of traffic rules amongst citizens and increased adherence to traffic rules, discipline and road safety. This can

easily be observed in reduction in cases of red light jumping. Public announcement system at traffic signals that calls out violators for flouting of rules has contributed significantly to this. For e.g. if a vehicle crosses the stop line and is blocking a turn, through the public announcement system the vehicle number is called out immediately and the driver asked to take the vehicle behind the stop line

- Centralization of data collection at TCC and operations has allowed for quick coordination and improved road safety.

### Optimization of Resources

- ITMS is a cost effective way for traffic management as automation of the system has reduced dependency on field human resource requirement is greatly reduced
- Overall the revenue earned from ITMS has been INR 2.65 Crores from January 2019-February 2021. This includes the months of strict Covid-19 lockdown during which movement was extremely restricted.

### Evidence Based Decisions

- Photos captured through adaptive traffic control system, ANPR, RLVD, SVD provide evidence of violation which is easily accessible for real time analysis. This serves as evidence of violations.

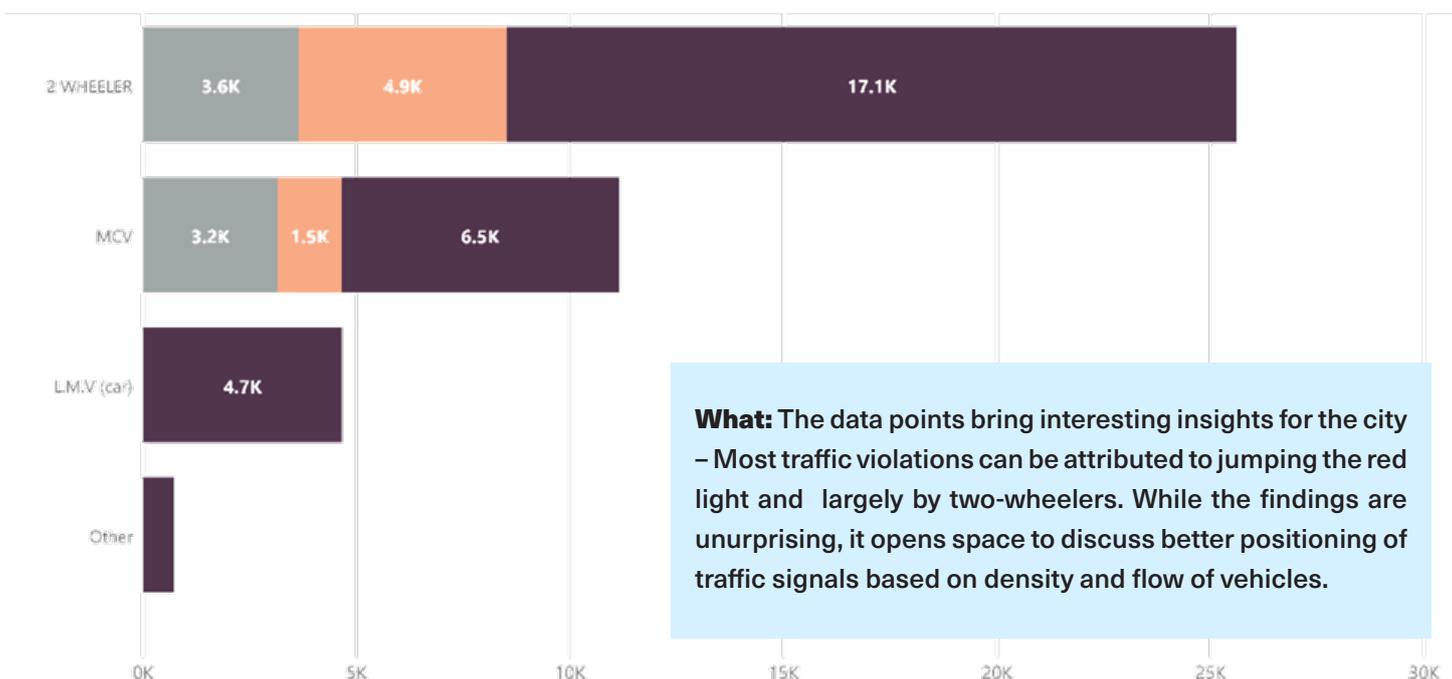
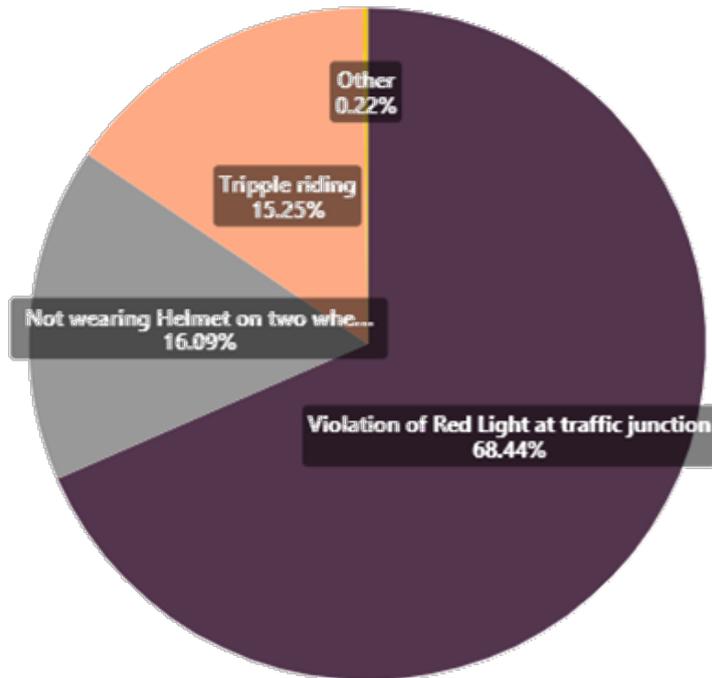
- Automation of the challan issuance system has increased transparency and provided insights to the number of challans generated in comparison to revenue through challans. This has allowed to identify the challenges in the system and determine the corrective course of action.
- E-challan system has also made it possible to maintain a database of challans issued and carry out analysis for informed decision making such as traffic violations or locations to be focused upon, and so on.

### Recovery of Stolen Vehicles

- ANPR is also effective for tracing stolen vehicles. [Mota data software](#) is used for importing stolen vehicles data from the police department. When vehicle is identified through cameras, softwares generates an alert for stolen vehicle found

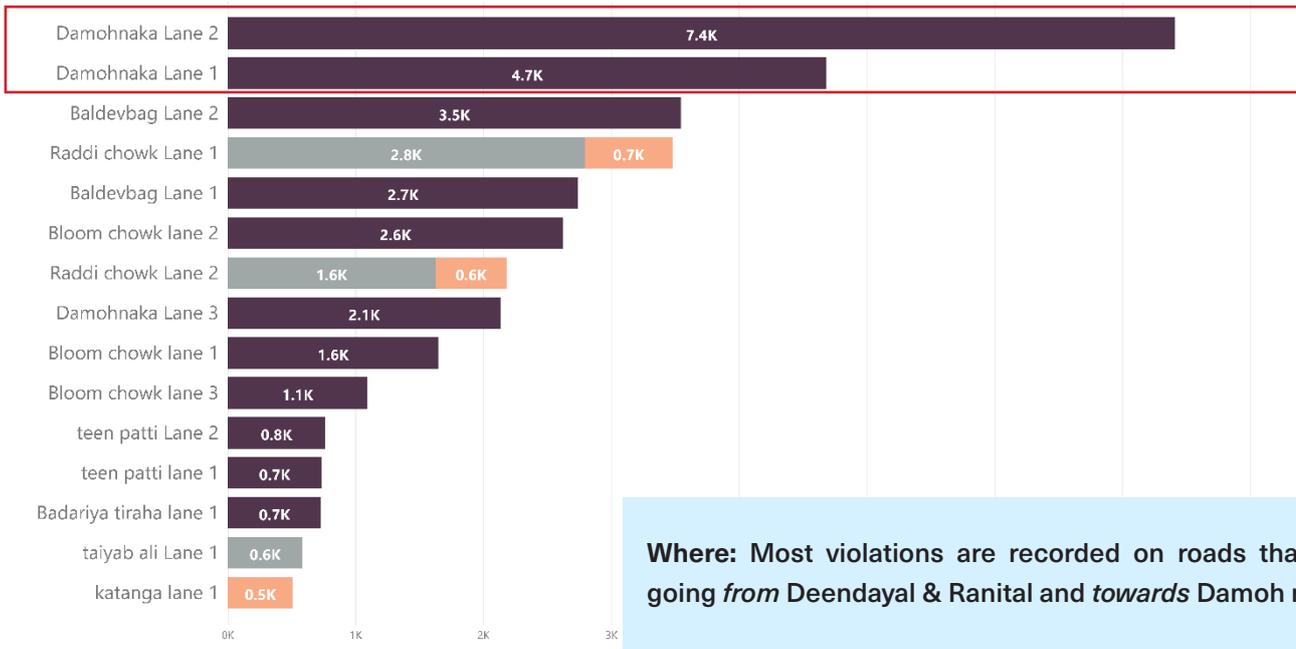
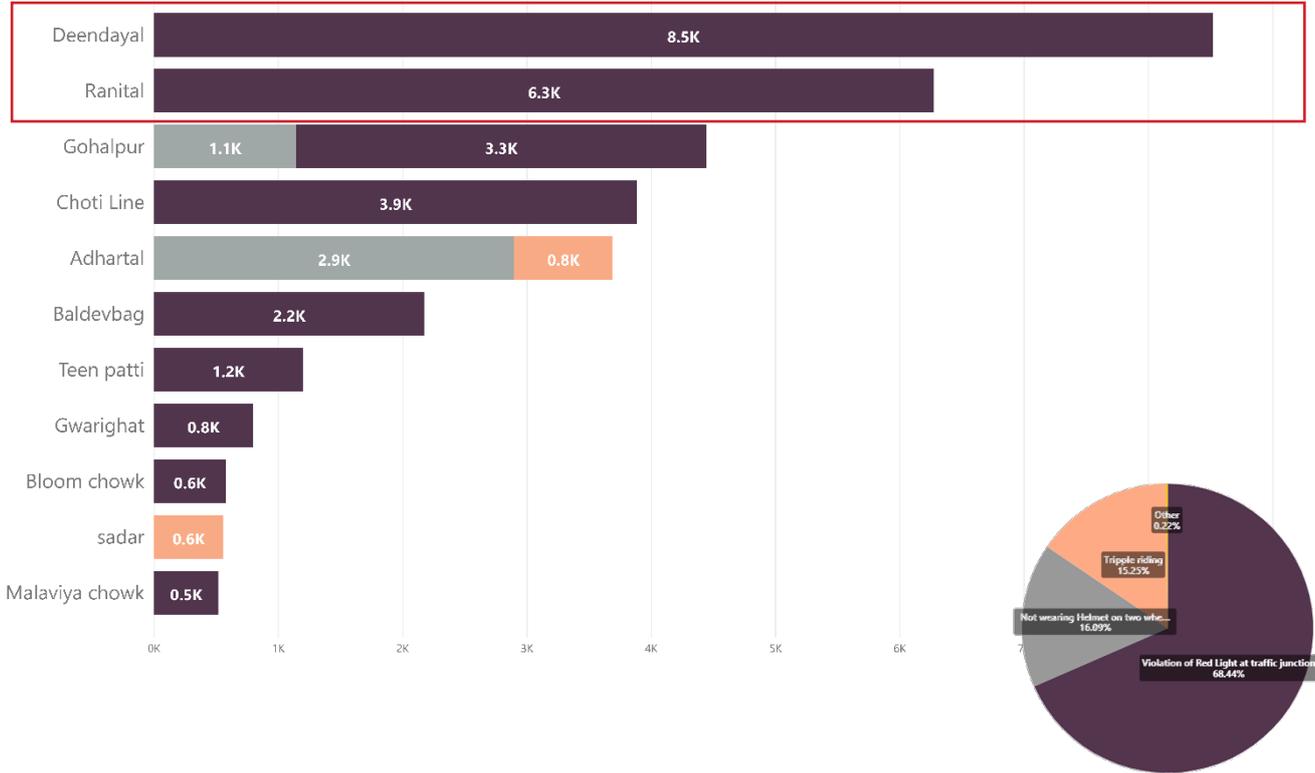
# Key data-stories

## Understanding Traffic Violations Patterns



**What:** The data points bring interesting insights for the city – Most traffic violations can be attributed to jumping the red light and largely by two-wheelers. While the findings are unsurprising, it opens space to discuss better positioning of traffic signals based on density and flow of vehicles.

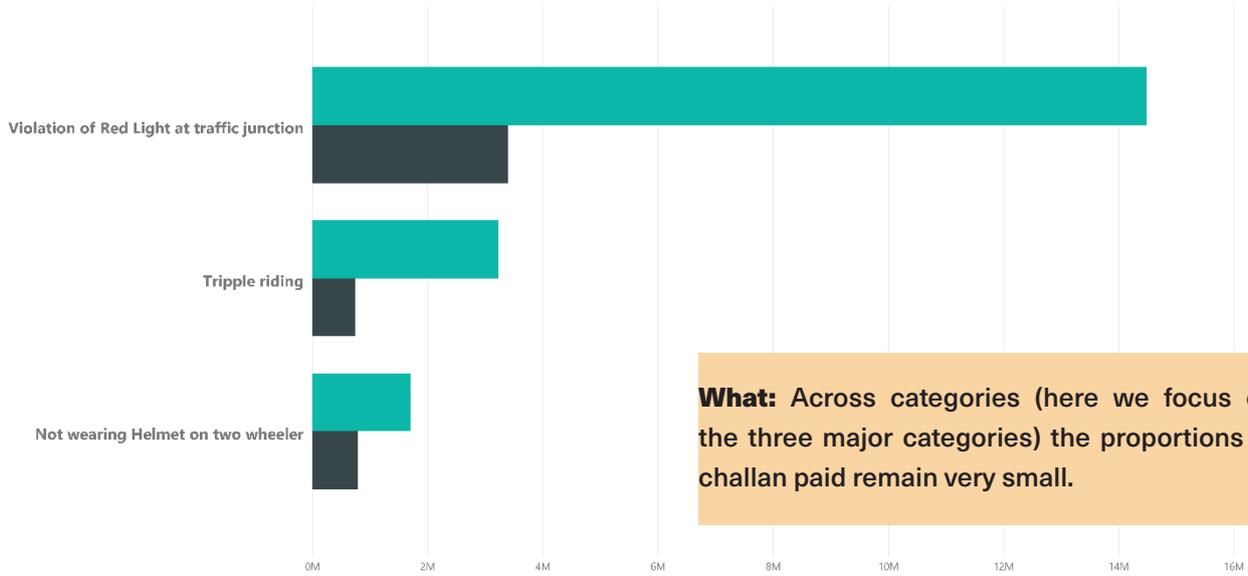
## Understanding Traffic Violations Patterns



**Where: Most violations are recorded on roads that are going *from* Deendayal & Ranital and *towards* Damoh naka.**

## Understanding Challan Payment Patterns

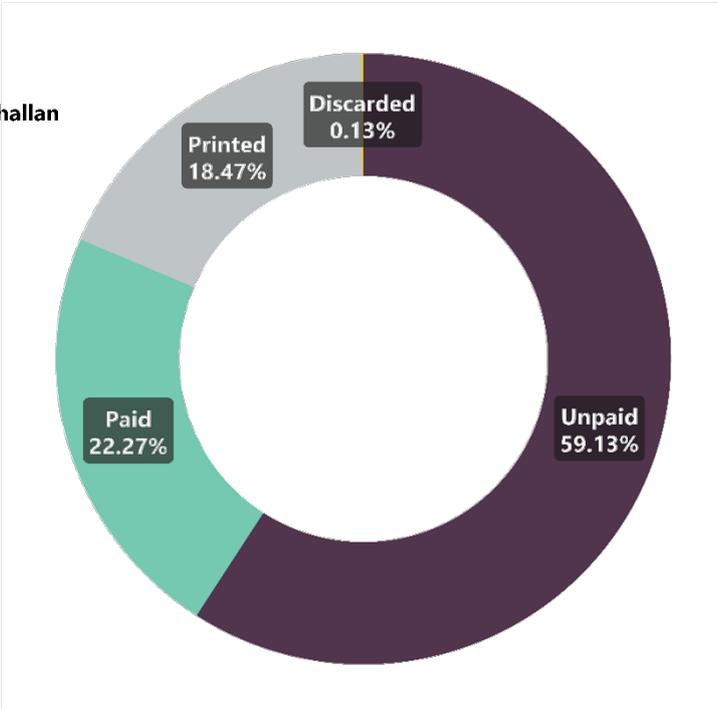
● Amount ● Fine Paid



**What:** Across categories (here we focus on the three major categories) the proportions of challan paid remain very small.

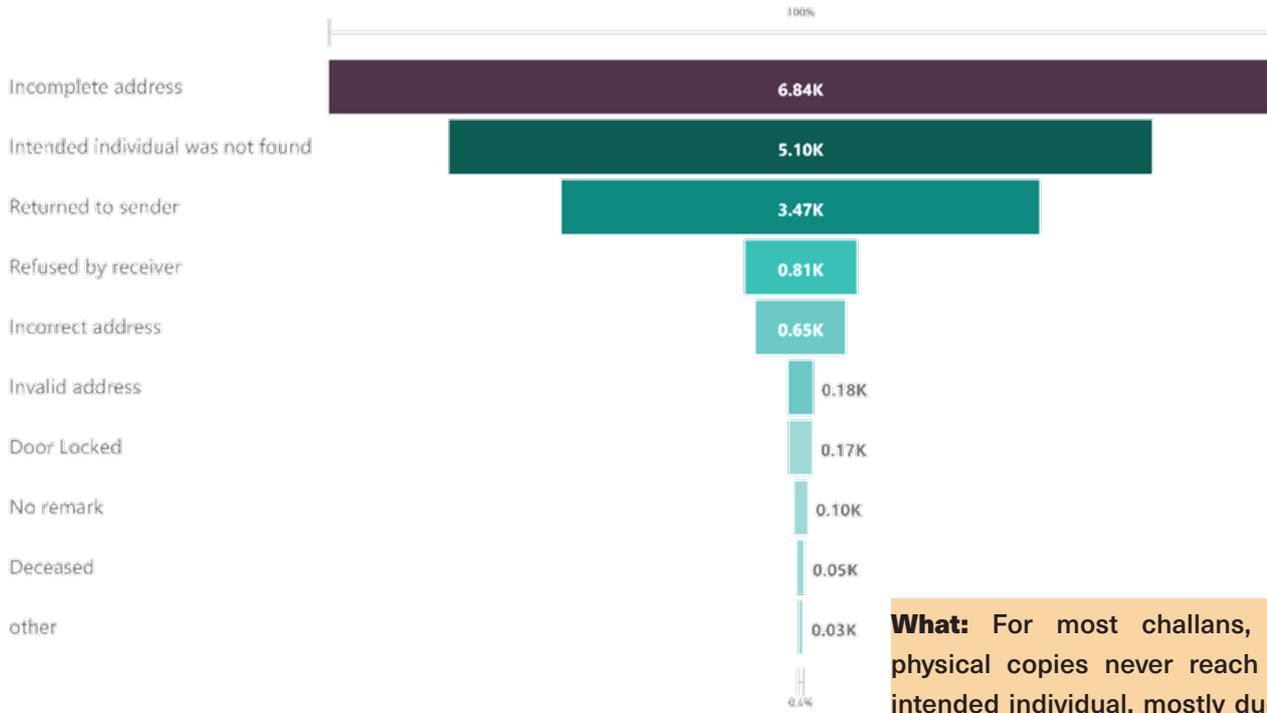
Category of Violation & Delay (in days) in payment of Challan

Tripple riding	-3.68	298
Average		Max
Violation of Red Light at traffic junction	-7.26	302
Average		Max
Not wearing Helmet on two wheeler	-10.71	78
Average		Max
Other	-16.50	-12
Average		Max



Interestingly, even though over 59% of challans remain unpaid, delay in payments is not a secondary issue that the city faces. Most challans are paid well within due dates (*the table on the left shows delay in payment in days - a negative number indicates early payment*)

## Understanding Challan Payment Patterns



**What:** For most challans, the physical copies never reach the intended individual, mostly due to faulty, incomplete or old address



Total revenue collected through challans has shown consistent incremental improvement (*the chart above shows data for 2021*). The revenues flatlined momentarily during the lockdown period, but have since consistently picked up. It is noteworthy, however, that given our discussions around unpaid challans and other challenges discussed in the case, this revenue collection is much below the potential.

# Conclusion

Jabalpur is a part of the club of a few cities that are leading the way and illustrating how urban commute does not have to be synonymous with long haul traffic jams and traffic rules violators. Traffic congestion in urban spaces which have a vibrant economy is a challenge most cities face.

Traffic jams are perceived somewhat as symptoms of a fast paced 21st century modern life. Cities around the world, especially smart cities are devising and implementing intelligent traffic management system. They've proven that by uniting data with communications technology and artificial intelligence, it is possible to improve the commuting experiences.

In order to ensure sustainability of the project and ensure long term effective implementation, it is important to ensure the following points:

- One way to overcome the challenge of irregular updation of RTO data is to collaborate with the central government to integrate RTO data with vehicle insurance policy, since, the vehicle insurance policy data is updated regularly on an annual basis for every company.
- Enable the provisioning of e-challans through emails to optimize the time and costs involved in challan deliveries.
- Optimization of datasets can reduce the file size which will speed the analysis process.

This can be as simple as receiving address, name and other details with limited characters.

- Till a mechanism for revenue sharing is established, enhancing cooperation with other stakeholders such as the police department can allow for cost sharing. For instance, currently, 15 computer operators have been hired. Through adequate training, police personnel can also be trained to operate the system.
- The current data collected provides insights into traffic density at a given location at a given point of time. This data can be leveraged to improve management of priority vehicles such as ambulances, fire engines – by route optimization and reduction in commuting time.
- Immobile vehicles at traffic signal create air pollution. A study<sup>12</sup> by Harvard Center for Risk Analysis links premature deaths to increase in air pollution and social cost. Managing the traffic signal including wait time at a red signal can further manage the air pollution created from idling vehicles.
- Improved traffic management also reduces the overall carbon footprint of a city and results in fuel saving.

## Looking Ahead

Jabalpur has made significant strides in improving the traffic management in the city. Going

ahead, the data points towards several areas of opportunity where the city can incrementally improve to streamline traffic management and revenue for a sustainable solution.

The high proportions of unpaid challans (*read key data stories in the previous section*), when read against the many reasons for challans being returned/undelivered to the intended individual, points towards the need for better coordination with partners like Indian Postal Service, cascading benefits of improved platform solutions for allied departments/partners (RTO, Indian Postal Service etc.) to improve data quality & management across the ecosystem.

There is also the opportunity of re-aligning the traffic management related infrastructure (signals, road signs, junctions & networks, stops & exits and so on) to actual vehicular flow & density on road, connectivity & need, peak hours, among others. Persistent violations are also a symptom of mobility & traffic system that needs to respond to the city's felt requirements.

## Endnotes

1. Such as adaptive traffic signals, real time traffic feedback, red light violation detectors etc.
2. An MOU was signed since both the police and transport department are independent of the Jabalpur urban local body.
3. The Integrated Command & Control Centre (ICCC) is an integrated system that operates & manages multiple city service operations including real time data monitoring & improving services delivery efficiency.
4. The Regional Transport Office is responsible for maintaining a database of drivers and vehicles.
5. An application programming interface, is a computing interface that defines interactions between multiple software intermediaries.
6. The areas were identified through a survey by DIMTS.
7. Installation done on the basis of site reconnaissance and secondary data collected from Jabalpur traffic police.
8. Installation on the basis of speed analysis and site reconnaissance by DIMTS.
9. Mota data also reports the functionality status of the hardware. If a camera is off, software alerts so that it can be repaired.
10. Earlier, license plates were issued by RTO: the style was black numbers on white background. RTO has now discontinued the issuance of number plates.
11. As per the Motor Vehicle Act, challan has to be presented to the offender in the form of a hard copy.
12. The study titled, "Evaluation of the public health impacts of traffic congestion: a health risk assessment", can be accessed [here](#).

# Abbreviations

<b>ANPR</b>	Automatic Number Plate Recognition System
<b>API</b>	Application Programming Interface
<b>ITMS</b>	Integrated Traffic Management System
<b>DDG</b>	Data Driven Governance
<b>DIMTS</b>	Delhi Integrated Modal Transit System
<b>DPR</b>	Detailed Project Report
<b>ICCC</b>	Integrated Command and Control Center
<b>ITMS</b>	Intelligent Traffic Management System
<b>MoHUA</b>	Ministry of Housing & Urban Affairs
<b>RFD</b>	Radio Frequency Identification
<b>RLVD</b>	Red Light Violation Detection
<b>RTO</b>	Regional Transport Office
<b>SVD</b>	Speed Violation Detection Camera
<b>TCC</b>	Traffic Control Center
<b>ULB</b>	Urban Local Body
<b>VMS</b>	Variable Message Signboards

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