



गृह मंत्रालय
MINISTRY OF
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Project Report

On

B-TRAC – Technology Driven Traffic Management (Project No.05/MM:03)

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‘Promoting Good Practices and Standards’



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Project Leader	Dr. M. A. Saleem,IPS Special Commissioner (Traffic) Karnataka, Bengaluru
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1. **PREAMBLE:**

Due to increased urbanisation, the biggest challenge faced by police organizations across India is managing ever increasing traffic on roads. Indian Cities have witnessed not only exponential growth of population but also phenomenal growth in vehicles. As cities expand, the travel demand also increases leading to high volume of traffic. Increase in volume of traffic without corresponding increase in road infrastructure has resulted in traffic congestion, perennial traffic jams, pollution and increase in road accidents. Some of the significant problems leading to traffic congestion on Indian Cities are;

- a) Population boom due to economic growth
- b) Phenomenal growth in vehicular traffic
- c) Slow growth in transport infrastructure
- d) Poor urban traffic planning
- e) Lack of adequate public transport
- f) Zero parking infrastructure and unregulated parking
- g) Indiscipline among road users leading to;
 - i) Traffic congestion and bottlenecks
 - ii) Increased journey time
 - iii) Air and noise pollution

The above problems have largely contributed to huge traffic congestion in almost all Indian cities. Though majority of traffic problems is due to faulty urban planning by civic agencies, traffic police is most often blamed for chaotic traffic situation. In order to

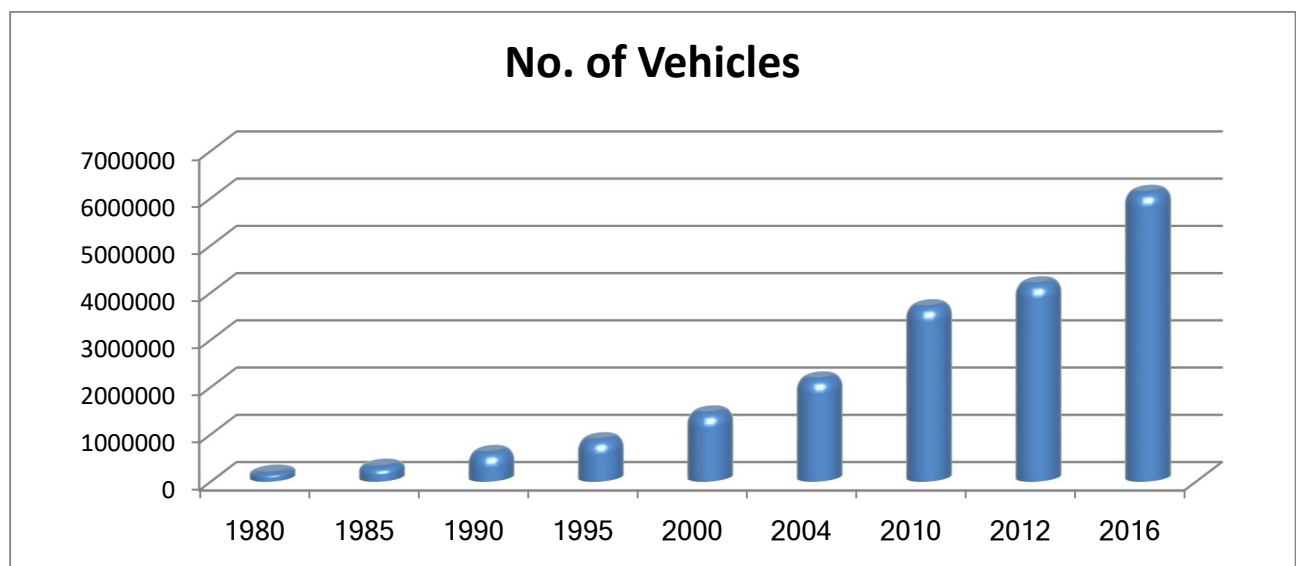
improve traffic situation and bring effective traffic regulation through use of technology, the Bangalore Traffic Police has initiated a unique project called '**B-TRAC**'.

Bangalore is one of the premier cities in India having a population of nearly 10 million and vehicle population of about 4.2 million. It is a city which has registered a growth of more than 4% year-over-year during the last 2 decades and is still growing on at even faster rate.

Bangalore Traffic Police looks after the regulation and enforcement aspects of traffic management in the city. It manages traffic on 11000 Kms of network and nearly 40,000 intersections. The geographical coverage of Bangalore Traffic Police is 1005 Sq.Kms. The sanctioned strength of Bangalore Traffic Police is 3260 and is supplemented by 500 Home Guards.

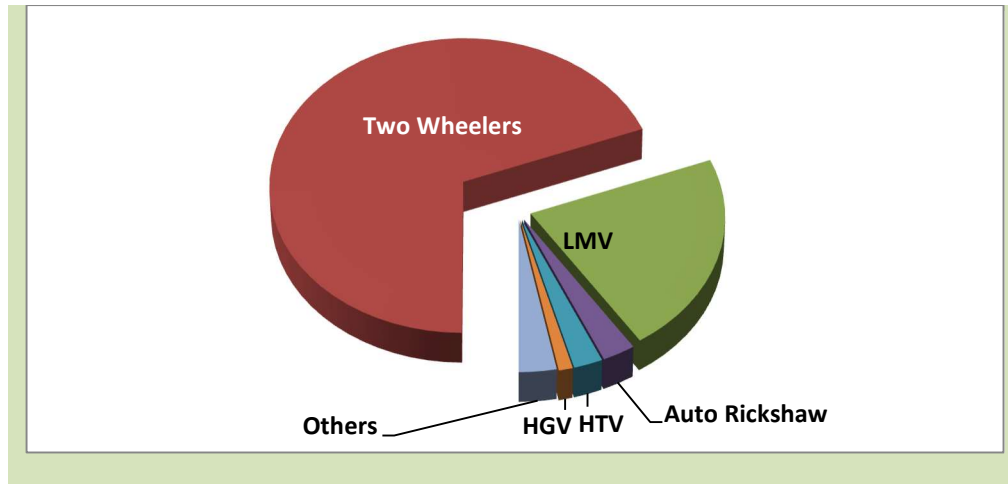
The growth of vehicles in Bangalore City is shown in the table below.

YEAR	1980	1985	1990	1995	2000	2004	2010	2012	2016 (31.03.2016)
No. of Vehicles	175325	306589	601059	870659	1438057	2157480	3686257	4171062	6108936



The following graph indicates different types of vehicles registered in Bangalore City.

Types of Vehicles registered in Bangalore City.



Phenomenal growth of population and number of vehicles registered in Bangalore City and the obstruction of carriage way by number of on-going works like Metro fly-overs, under-passes, over-bridges, the management of the traffic and ensuring smooth flow of the traffic has become a herculean task. In this background Bangalore Traffic Improvement Plan which is popularly known as B-TRAC was envisaged. The total estimated cost of the project is 350 Crores.

The scheme was started in the year 2006-07 and the total grants given by the Government is Rs. 217 Crores.

Though the Government had released funds from the financial year 2006-07, the implementation of the project started in the year 2007-08.

2. OVERVIEW

2.1 PROJECT TITLE : BANGALORE TRAFFIC IMPROVEMENT PROJECT

Bangalore City Traffic Police realizes that ever increasing expectations of citizens cannot be met by increasing the manpower alone. That is why there is a need for paradigm shift from manual regulation to technology driven traffic management plan.

The core philosophy behind B-TRAC plan is:

- Creating a reliable real-time traffic information system.
- Analyzing such information and utilizing the traffic intelligence thus generated for ensuring better traffic management and planning.
- Disseminating such information to public in real time for enabling them to make informed choices on the roads.

2.2 VISION:

B-TRAC is the 'first of its kind' project in the country to address the issues of traffic congestion, safety etc by utilizing the latest traffic management technologies and techniques, which are appropriate to our context. This will give the much-needed scope for larger infrastructure projects to be planned and implemented for improving the transportation system in Bengaluru city.

3 OBJECTIVES:

The objectives of B-TRAC are two fold;

3.1 Operational objectives:

- a) Reduce traffic congestion by 30% in central area
- b) Reduction in Pollution
- c) Reduction in accidents by 30%
- d) Improved parking management
- e) Achieve substantial compliance of traffic laws and rules
- f) Set up accident reduction and trauma care system

3.2 Institutional objectives:

- a) Co-ordinated traffic management by developing mechanisms for the same, like institutionalising Traffic Task Force, Road Safety Committees, Traffic Action Committee etc.
- b) Robust Revenue Model (traffic funds to pay for traffic management infrastructure and maintenance)
- c) Legal and institutional reforms
- d) Capacity Building (modernisation and up-gradation of Traffic Training Institute etc.) and
- e) Strengthening of Traffic police by augmenting officers and staff; construction of buildings and provision of modern communication and mobility.

4 COMPONENTS OF B-TRAC:

4.1 State-of-art Traffic Management Center

A State-of-art Traffic Management Center at a total cost of Rs.30 Crores was established on Infantry Road under B-TRAC project. The Traffic Management Center functions as a nerve center for all activities relating to traffic regulation and enforcement in Bengaluru City. The Traffic Management Center currently is responsible for;



- Gathering Statistics about Traffic Flow and related flow patterns
- Planning movement of traffic with the objective of avoiding bottlenecks
- Executing the traffic plan; keeping in view the local situation so as to incur least inconvenience to the commuter
- In the entire sets of activities, the core objective of the department is to ensure smooth flow of traffic with minimal intervention.

Features of Traffic Management Center are:

- Creation of a unified, dynamic and user-friendly interface for managing all the components remotely
- Integrated complaint monitoring system
- Management Information System
- Creation of a helpdesk
- Intelligent Traffic Signaling System
- Video Surveillance Cameras
- Mobile telecom operators
- Variable Messaging Systems
- Mobile communication



4.2 Centrally Controlled Traffic Signaling System

The Centrally Controlled Traffic Signaling System comprises of the following;

a) Automated Signaling System

Automated signaling is a concept wherein all the signals placed at various junctions of the city are centrally controlled from a Central Hub. Traffic signal at each junction is connected to a controller, which in turn is connected to Traffic Management Centre (TMC) using leased line. These controllers are intelligent and can be programmed to perform as per the requirements of specific location and time. Some of the visible benefits are:

- Centralized manipulation and monitoring of the traffic signals like timing and patterns on short-term or long term basis using state-of-art and innovative application software.



- Pre-programming of signal controllers at junctions with different phase/cycle times, in each direction, at different points of the time during a day and different days during a week. This is extremely helpful for handling peak hour and non-peak hour situations at junctions using different approaches. At present each signal in city has at least 4 to 5 programs. There is different time cycle for Saturdays and Sundays.

b) Vehicle Actuation

An underlying sensor (also referred to as loop) embedded below the asphalted road near the zebra crossing, senses the vehicles passing over it. The sensor is linked to a controller placed at the junction, which sends signals indicating presence or absence of vehicle over it. Every direction is allotted a minimum 9-second phase time to begin with. As long as vehicles are present on the loop, 4 seconds will continue to be added in the phase time i.e. 9,13,17 and so on, subject to an upper limit. In case of no vehicle passes for more than 4 seconds, the controller turns the signal red even if allocated green time is still unutilized. Hence, wastage of green

time is avoided and traffic from other direction is released. As a result of this technology, a total cycle time in each cycle will vary according to traffic flow.



Vehicle actuation avoids wastage of green time and encourages discipline by reducing signal jumping offences. The maximum benefits of vehicle actuation are experienced during lean hours and at junctions where different directions have different traffic densities.

During peak hours, when there is over saturation in all the directions, vehicles actuated signal functions like fixed-time signal.

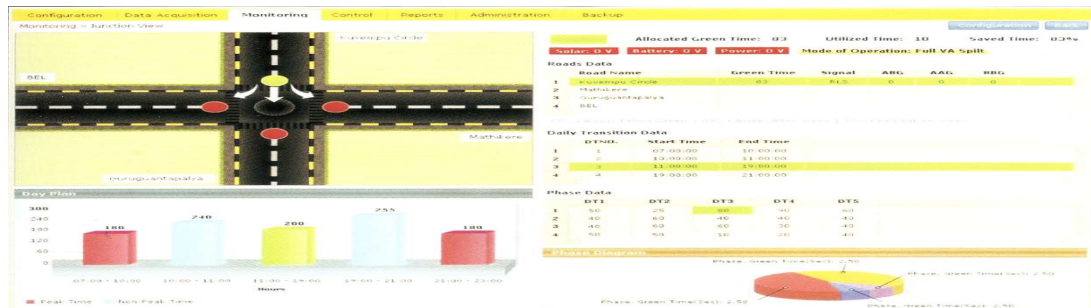
c) Signal Progression

This programme ensures that each junction turns green towards a priority direction in conjunction with its previous signal, in the same direction, but with a time traffic from a junction reaches the next junction it finds green signal awaiting them thus ensuring minimal wait at signals. The only short coming is that the time difference is manually fed and any modification of green time at a particular junction, participating in signal progression, can adversely affect the system. Moreover, signal progression works on the presumption of no non-signalized right turns in the corridor and an assumed average speed for all the vehicles. This concept is very useful for closely placed signals.

d) Area Traffic Control (ATC)

This concept is a combination of signal progression and vehicle actuation. In ATC, two sets of activities are conducted, namely;

- i. Optimization of green time allotted to each direction at each junction. A fixed time is allocated at each junction controller for each direction. This time is validated against the traffic passing in these directions; if it is observed that the entire allocated green time for a particular direction is not utilized then the green time in that direction is reduced by 10%. This activity is repeated till the optimum green time is achieved for each direction in all the junctions in the area or the corridor. In the entire process the embedded loops at junctions play an important role in detecting vehicles passing towards particular direction.



This information is processed by the controller placed at each junction and is passed to the central server placed at TMC, where an algorithm takes decision on green time optimization.

- ii. Alignment of each junction with one another so that signal progression can be implemented across a series of junctions falling in a priority direction. Such green time optimization happens all through the day. This change of time can cause the alignment between adjacent junctions, part of signal progression to

break. As such software running on a server at the central TMC automatically prevents such break up between these junctions so that vehicle actuation and signal progression work simultaneously.

e) Power Backup and Management At Junctions

The traffic junctions in the city of Bangalore are now equipped with high-end equipment with required uninterrupted power supply (UPS). The traffic police department has drawn up an elaborate arrangement, which ensures that power at each junction is uninterrupted. This plan is implemented using two levels:-

- Main power supply is provided to traffic signals using solar panels while networking devices and cameras are energized using BESCOM connections.
- The main power input is fed into an UPS, one each for networking devices, traffic signals and cameras, which provide a backup support for about 4 hours.

4.3 Enforcement Camera System

High resolution cameras placed at various junctions are meant to capture pictures of vehicles over



speeding or jumping signals. These cameras are connected to central server kept at TMC using 4 Mbps leased lines. The central server also has the capability to interpret the number plates using alpha numeric character recognition software.

This registration number is matched with transport department database for generating notices to violators.

4.4 Surveillance Camera System

332 junctions across the city of Bangalore are fitted with Pan-Tilt-Zoom cameras, capable of



capturing live feeds and pass on them to the TMC where a 24-Terabyte storage solution is used to store the feed for a period of 15 days. The live feeds have their own strategic importance in regulating traffic as well as designing of traffic signals based on actual vehicle counts. Soon video analytics will be used to intelligently interpret these feeds.

4.5 Speed Interceptors

Realizing that it is not possible to have video surveillance for every junction or locations between the junctions, police has deployed nine-interceptor vehicles equipped with surveillance camera, laser speed gun and alcometer for recording the violation and prosecuting the offenders while on move.

4.6 Automated Enforcement System

Automated enforcement also known as contact less system of booking of traffic violations was initiated in the year 2003. In this system violations recorded through digital cameras and enforcement cameras are processed at Central Automation

Centre and notices are sent to the owners of the vehicles involved in traffic violations. This is a highly transparent method of booking of cases against the traffic violators.

Bangalore Traffic Police has tied up with Bangalore-One, a citizen-friendly initiative of e-Governance department, for enabling anywhere, anytime payment of the fines imposed. Citizens can settle the violation tickets issued against their names as well as parking violation tags issued to them by visiting any Bangalore-One centre or any traffic police station.

These places are connected using a dedicated network to the central application server kept at State Data Center (SDC). Citizens can also pay their traffic violation notices and parking violation tickets online through traffic police website from the comforts of their home.

4.7 Blackberry driven Enforcement

Traffic Police has equipped its officers with handheld BlackBerry devices connected to Bluetooth-enabled printers. These devices are connected to a central server kept at State Data Center (SDC).

BlackBerry wielding officers enforce traffic rules and regulations and fine offenders. All these activities are done online resulting in real time monitoring and statistical analysis for the senior officers' review.



Online booking of violations using BlackBerry also ensures tracking of habitual traffic offenders thus ensuring enhanced punishment for them. In addition, it also tracks down unpaid violation notices issued in past.

4.8. Traffic Scan through GPS

600 BMTC busses running in Bangalore city are fitted with GPS devices. This facility is used to identify congestion across the roads of Bangalore and a real time GIS reporting mechanism projects the data thus collected into a map of the city. The time taken to travel between two locations of the city at a non-peak hour is taken as base time and any deviation from that is used to identify three basic traffic patterns, namely, heavy traffic (red) medium congestion (orange) and free flowing traffic (green).

4.9 Traffic Scan through Mobile Density

A supplementary mechanism of identifying congestion is by using density of mobile devices currently existing under a particular mobile tower. This value is processed for identifying the level of congestion at a particular junction and subsequently the processed data is used to create a real time GIS enabled map at TMC. The higher the number of mobile devices under a particular tower the more

likely is the chance for congestion. The only weak point is this mechanism is that the system is capable of identifying congestion at the round junctions only.

4.10 Variable Messaging Systems

Message boards mounted on large gantries are being placed at convenient locations of the city for displaying traffic related information. This information is fed into terminals placed at TMC from where the message is relayed on to the boards using radio frequency waves. The information displayed informs the travelers about existing traffic scenario to help them avoiding traffic snarls and making informed choices.



4.11 Parking Information System

All major parking places in the city of Bangalore, which are computerized are proposed to be connected to the TMC using web based services. The real time parking availability status from these parking places will be relayed to the traffic Police web site and made accessible to the citizens through VMS board and phones using SMS on need to know basis.

4.12 Multi-phased public interaction

- a) **Facebook**: In order to interact with public and to address their traffic related complaints and valuable suggestions, a platform is created by opening an account in facebook a social networking website. Bengaluru Traffic Police Facebook has more than 4 lakh followers as on March-2016.
- b) **Twitter**: A platform is created to the general public to interact with Bengaluru Traffic Police through twitter. Citizens of Bengaluru City is actively participating in regulation of traffic, enforcement of traffic rules. Bengaluru Traffic Police twitter has more than 1.2 lakh followers as on March-2016.
- c) **SMS Alerts**: BTP is also sending free traffic alerts to its subscribers regarding traffic situation. Anyone can subscribe to the service by sending SMS JOIN<space>BTP to 09219592195. As on March 2012 more than 35,000 people have subscribed to this facility.



5 FINANCIAL IMPLICATION OF THE PROJECT:

The total grants released by Government and the expenditure towards implementation of B-TRAC project from the period from 2006-07 to 2014-15 is as follows;

Sl. No.	Year	Released (Rs. in Crores)	Expenditure (Rs. in Crores)
1.	2006-07	44.00	0.14
2.	2007-08	0.00	19.76
3.	2008-09	35.00	26.98
4.	2009-10	40.00	32.92
5.	2010-11	5.00	27.66
6.	2011-12	15.00	11.73
7.	2012-13	25.00	12.64
8.	2013-14	0.00	24.08
9.	2014-15	11.00	17.71
10.	2015-16	42.00	0.85
Less: 5% Administration Charges on Expenditure of 2014-15			
TOTAL		217.00	174.47

6 IMPACT OF B-TRAC PROJECT

B-TRAC 2010 is the first of its kind project in the Country to address the issues of traffic congestion, safety etc by utilizing the latest traffic management technology and techniques, which are appropriate to our context. This will give the much-needed scope for larger infrastructure projects to be planned and implemented for improving the transportation system in Bangalore city.

Implementation of B-TRAC project has resulted in improvement in traffic regulation, enforcement and reduction in road accidents. The impact can be seen under the following heads;

1) Transparency in enforcement of traffic rules:

Replacing the paper based challan system with automated enforcement and BlackBerry based challaning system has brought in lot of transparency in booking of cases against violators of traffic rules. Permanent records are created for traffic violations through automated enforcement. Automated enforcement has helped in identifying the repeat offenders. The new system has resulted in increased number of registration of cases and an increase in collection of traffic fines, as appearing from the following table:

Sl. No.	Year	No. of Cases registered	Total Fine amount Rs. In Crores
1	2007	1444098	19.91
2	2008	2079071	29.51
3	2009	2640286	37.62
4	2010	3333112	47.56
5	2011	4790841	50.56
6	2012	5204800	53.85
7	2013	5432812	56.98
8	2014	7436284	65.92
9	2015	7626671	70.44
	2016 (30.06.2016)	4438760	31.28

2) Substantial compliance of Traffic laws and rules

The use of surveillance camera, enforcement camera, field traffic violation report (FTVR) and breath analyzer to identify and prosecute drunk drivers/riders, has brought in greater discipline among the road users. Identification of repeat offenders has resulted in suspension of more than 20,000 driving licenses during the current year.

3) Reduction in road accidents

One of the important achievements of B-TRAC project is reduction in number of road accidents. Accident Scenario has seen a positive change and severity of the accidents has come down due to strict automated enforcement. The reduction in number of accidents is shown in the table below:

Sl. No.	Year	Road Accidents In Nos.
1	2002	9856
2	2003	10505
3	2004	9101
4	2005	7578
5	2006	7561
6	2007	8426
7	2008	7772
8	2009	6875
9	2010	6483
10	2011	6024
11	2012	5502
12	2013	5230
13	2014	5004
14	2015	4828
15	2016 (Up to 30.06.2016)	2520

4) Reduction in traffic congestion in central areas

The topography of Bangalore city is typically full of crossroads. Handling the cross traffic is difficult, but this task is also being managed efficiently. It



Map showing one-way roads

is for these very reasons around 190 roads were made one-ways in phases, and chaos in traffic has reduced to a great level and conflict points were resolved to a greater extent thus easing the traffic flow.

5) Reduced travel time due to scientific fine-tuning of signal timings at junctions

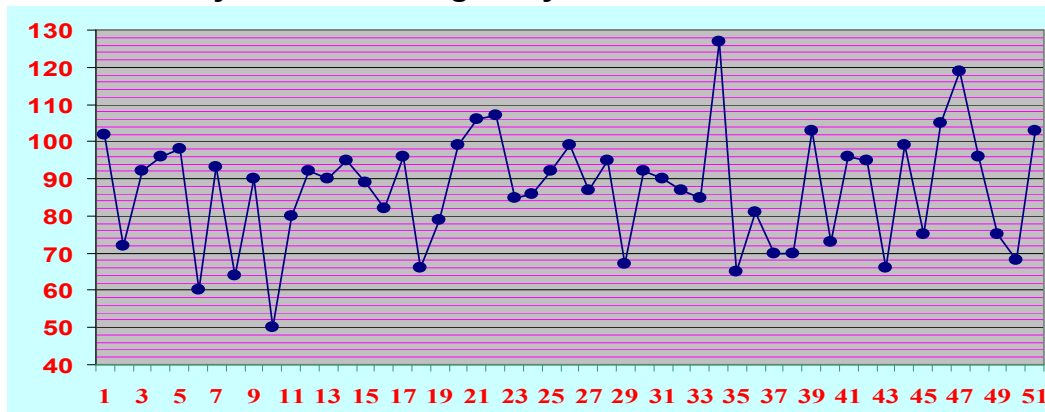


TLC-Silverlight Application

Junction Phase timing Map

Average savings in green time by using customized traffic light configuration system

6) Reduced Journey time due to Signal synchronization



The average journey speed has increased from 18 Kmph to 23 Kmph in the city after the implementation of B-TRAC project. This is largely due to synchronization of signal lights on 10 important traffic corridors. Synchronization coupled with central control of traffic.

7 B-TRAC Evaluation by Indian Institute of Science (IISc), Bengaluru

The Center for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), Indian Institute of Science (IISc), Bengaluru has conducted Evaluation and impact study of the B-TRAC project. As per the study, the positive impacts of B-TRAC project are;

1. Junction improvements in 46 junctions have helped in systematic movement of traffic.
2. The travel time has reduced due to signal optimization and journey speed has increased after synchronization of signals.
3. The road markings like centerline, median markings, lane markings and edge line markings on some major roads have helped in safer movement of traffic.
4. The enforcement cameras, blackberry's and printers have helped in catching the traffic violators and also increased the collection of fines. The surveillance cameras have helped in better monitoring and management of the traffic and also in catching traffic violators and also in increasing the collection of fines.
5. The Variable Message Signs (VMS) have helped in giving advance information to the drivers so that they can deviate and can take alternate routes.
6. The Street Furniture's like Flexible Cone with Reflective Tape, Cats Eye, Hazard Markers, Reflective Median Markers, Movable Steel Barricades, Informatory Signboards have helped in reduction of accidents and safe movement of traffic.
7. B-TRAC project has helped in reducing the accidents by 18% between three years from 2007 to 2010. The accident rate of Bangalore City has come down because of various measures taken by Bangalore Traffic Police. Some of the measures taken by Bangalore Traffic Police are given below,

- 1) **Effective Enforcement of Traffic Rules:** Bangalore Traffic Police have registered highest number of traffic violations in the year 2012 i.e., 51.30 Lakh cases were registered and Rs. 53.85 Crores of fine amount were collected from the violators. This is the highest number of cases booked and highest fines collected in any city in the world.
- 2) **Suspension of Driving License of Repeated Offenders:** A database of repeated offenders was made and their driving licenses were seized.
- 3) **Automation Enforcement:** To bring in more transparency in payment of fines 500 digital cameras were provided to policemen manning the junctions and during the year 2012 and 16,91,863 cases were booked using the cameras.
- 4) **Implementation of Uniform Speed Limits:** In each of the traffic police limits, prominent road junctions were identified and campaigns were undertaken to bring awareness of speed limits through advertisements. Additional four interceptor vehicles were used to book 1.19 Lakh cases against violating individuals who were riding their vehicles in rash and negligent manner.
- 5) **Campaigns:** Various campaigns has been conducted like drunken driving campaign, lane discipline campaign, ambulance priority campaign, innovative public eye campaign, seat belt campaign, helmet less campaign and campaign to remove tinted glasses. An effective campaign against helmet less two wheeler drivers was conducted in 2012 in which a total of 7.52 Lakh cases were registered.

- 6) **Auto Rickshaw Reforms:** In Bangalore City, the autorickshaw drivers refuse to go for hire and also demand excess fare and in this regard huge complaints were raised by the public with the traffic police. The police have taken the following actions,
- a) Sixteen prominent places were identified to start pre-fixed auto counters.
 - b) The Auto Display Card System was revitalized so that the card was displayed more visibly to the passengers boarding it and whenever things were left behind in the autorickshaw, they were traceable because of the campaign.
 - c) The IVRS complaint system to report demanding of excess fare and refuse to go for hire was established enabling prosecution of the autorickshaw drivers.
 - d) The SMS facility was also provided to register complaints against such erring auto drivers.
 - e) Complaint by emails against the erring auto drivers was also established.
 - f) The above listed measures have helped the citizens immensely thus reducing the number of complaints.
- 7) **Road Safety Training:** Road safety training was imparted for private transport vehicles and school bus and van drivers so that it results in less accidents
- 8) **Removal of Unscientific Road Humps:** Unauthorized and unscientific road humps were identified and removed in Bangalore City because they were contributing to fatal accidents. On the main roads, to control road accidents occurring due to overspeeding vehicles road humps has been installed as per IRC standards.
- 9) **Establishment of Three New Traffic Police Stations:** With an increasing vehicular population and an effort to reduce road accidents three new traffic police stations

were commissioned. They were a) Kengeri Traffic Police Station b) Jalahalli Traffic Police Station and c) Hulimavu Traffic Police Station.

10)Effective Citizen Interaction: In order to ensure smooth traffic flow and to reduce road accidents in Bangalore City, Citizen's Traffic Forum was started under the Chairmanship of Commissioner of Police. On every 3rd Saturday of the month police station level meetings will be held in all 42 Traffic Police Stations involving general public between 11.30 a.m. and 1.30 p.m. A 'Bangalore Traffic Police' facebook page has also been created which has more than 57,000 followers.

8. COST BENEFIT ANALYSIS:

It is seen from the financial implication that a total of Rs. 217 Crores were provided by State Government for the implementation of B-TRAC Project. Out of this Rs. 174.47 Crores expenditure is incurred on various B-TRAC components. Most of these funds are being utilised to improve traffic regulation and enforcement of traffic rules in Bengaluru City. Due to introduction of technology in enforcement, Bengaluru Traffic Police could realise Rs. 463.63 Crores through collection of fines from the the violators of traffic rules. Therefore it is seen that, the project has not only has financed itself, but has also provided additionally more than Rs.250 Crores to the Government.

Thus, the B-TRAC Project is a self financing model and sustainable. The State Government needs only to provided small grant in the beginning and get back the entire amount through fines collected from violators o traffic rules.

9. THE WAY FORWARD:

The initiative has started yielding results from the first day itself. The changes and the impact were dramatic and exceeded the expectations of the department. Here it is essential to state that the objective of the entire exercise was not to increase the revenue collections but to enhance the quality of traffic enforcement & traffic management by ensuring that violations are recorded and violators are penalized as well as traffic accidents are reduced.

The B-TRAC project was recognized by Government of India and Bangalore Traffic Police have received the following awards for its implementation.

1. ***National Award for Best use of Information and Communication Technology (ICT)*** by the Dept of Personnel and Training (DoPT), Government of India in the year 2011.
2. ***Award for Excellence in Urban Transport***” Honoured by **Ministry of Urban Development, Government of India.**
3. ***“Golden Peacock Award”*** for Innovative Product / Service honoured by **Institute of Directors (IOD) and Golden Peacock Secretariat.**
4. ***“Golden Peacock HR excellence Award”*** honoured by **Institute of Directors (IOD) and Golden Peacock Secretariat.**
5. ***“Namma Bengaluru Award”*** honoured by **Namma Bengaluru Foundation, Bengaluru.**
6. ***“Best Project Award-2014”*** by Ministry of Urban Development.
7. ***“Skoch Platinum Award-2014”*** for best traffic management, good enforcement and reduction in accidents.

8. ***“Best Practice Award-2014-15”*** by Directorate of Municipal Administration, Govt. of Karnataka and City Manager’s Association, Karnataka.

It is seen that many components of B-TRAC project like Automated Enforcement, e-challaning system etc are being implemented in many cities across India. In order to implement the project, the financial support from the concerned State Government is essential. Therefore it is recommended that traffic police organizations of important cities can implement this innovative scheme to bring greater efficiency in traffic regulation and enforcement. The systematic implementation of sustainable components of B-TRAC project will result in making our towns and cities more livable.