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Research paper



DMAIC Approach for Road Wellbeing: A Case Study

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Abstract

The objective of this paper is to implement the DMAIC methodology for finding out the reason for the traffic jam in the NH-24 connecting Delhi, Ghaziabad and Noida and finding out the solution for reducing them. For this survey, we have collected the data of a fixed route for 14 days and implemented various statistical methods for analyzing it. The study, focused on various junctions because these are the points, which are more prone to congestion. It aimed at finding out the critical junction and suggest improvement in them. As the number of vehicles is on the rise, it is the need of the hour to solve this problem

Keywords**:** *Critical junctions;DMAIC; NH-24; Statistical method;Traffic Jam*

1. Introduction

This India is one of the fastest growing economies in the world with one of the highest motorization growth rate. This has led to the rapid expansion of the road network and the urbanization but this growth is not able to deal with the increase in the number of cars hitting the road every day, the highways which were suitable previously cannot meet the present requirement.

In the year 2014 the number of vehicles per thousand people in Delhi was 409 which became 424 in the year 2015 which is an increase of 3.54% similarly in Uttar Pradesh number of vehicles per thousand people was 90 in 2014 and showed an increase of 11.11% becoming 100 in the year 2015 [5]. Due to the economic boom and the increase in the options at every segment of vehicles, the number of vehicles being registered is on the rise. This increase has lead to the increase in the traffic jams and the road accidents occurring each day as the number of the inexperienced drivers is also increasing. Most of the drivers do not know the traffic rules and in 2015 386,481 accidents occurred due to drivers fault resulting in 106,021 fatalities 401,756 injured people [5]. The accident caused due to the fault of the driver was whooping 77% of the total number of accident in the year 2015. This shows the lack of knowledge of traffic rules among driver if we take into consideration the type of license 79.1% of the accidents were caused by the driver having regular license 11.9 % had learning license and 9 % were those without a license in 2015. This data raises the issue on the methodology of issuing the license in India.

Apart from the mistakes by the driver, there are many other factors. Improper planning of the road is one of them it includes the presence of too many junctions, faulty dividers and traffic signals, the absence of proper management for public transport, the road being acquired for parking and unplanned stops of auto rickshaw. The Government of India has understood the graveness of the situation and set up the institutes like Institute of Driving and Research (IDTR) which aims at setting up the model driving training institute in every state.

2. Traffic Congestion-Consequences

On an average people in the NCR take 30 - 45 min as the additional time in order to reach their destination on time. If we consider a regular worker who goes to work using four- wheeler in NCR he will spend up to 8 days on road yearly. We can consider this as a huge opportunity loss as the worker is idle and non-productive during this period, in long term can cause a hindrance to the economic growth of the region. This irregularity on the time spent on the road incurs a loss in the business; it is usually fatal for the transportation and delivery business as the improper determination of the buffer time will result in a loss.

Apart from economic factor, it also has a negative impact on the environment and people. The rise in the pollution level due to the increase in the level of Carbon Dioxide emission and the other pollutants from the vehicle has caused an increase in the cases of respiratory diseases among motorist. The impact of road congestion is not limited to the physical well-being of a motorist but it also affects the mental state as long idle time usually causes the increase in the level of stress and frustration, which ultimately is the root cause of road rage. Traffic congestion deteriorates the condition of the vehicle in the form of reduced tyre life, collisions and reduced engine efficiency. Moreover the secondary routes

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created by the vehicles by going off-road causes loss to the real estate [1].

The traffic congestion not only causes the problems like wastage of money & time, stress, fatigue, and backache but it also raises the concern for road safety. During 2014-15, there has been a rise of 2.5% road accidents and 4.6% increase in the number of people killed in it. The number of the person killed per 100 accidents increase from 28.5 in 2014 to 29.1 in 2015. According to the road accident data of 2015 in India 1,374 accidents and 400 deaths every day this can be stated as 57 accidents and 17 deaths every hour. These accidents not only cause financial loss but also the loss of the precious human resource as 54.1% of people facing the accidents are between 15-34 age group. Among the different types of roads, National Highways are most chaotic [5].

Table 1*:* Number of Accidents, Persons Killed & Injured as per Road Classification (2015)

Road Classification	***National Highways***	***State Highways***	***Other Roads***
No. of Accidents	1,42,268 (8.4%)	1, 20,518(24%)	2, 38,637(47.6%)
No. of Persons Killed	51,204(35%)	40,863(28%)	54,066(37%)
No. of Persons Injured	1,45,341(29.1%)	1,31,809(26.3%)	2,23,129(44.6%)
Note: Figures within parentheses indicate share in total accidents, killed and injured in the respective road categories.			

3. Case Study

For our study, a group of 3 members was formed consisting of 1 faculty and 2 students. All the 3 members traveled from different destinations to reach the college but the most problematic route was almost 13 km long which was common, our study is focused on the study of this route. In our daily commute we are wasting on an average 23% of our of our total travel time in a traffic jam by being unproductive. As the junctions are more prone to traffic congestion, we have analyzed them carefully.

We took this study because this delay is causing loss to the students in the form of missing the lectures and faculty have to spend the time on the road being unproductive, as they usually have to consider this delay for reaching on time. Moreover, the daily office worker usually tries to compensate this time by rash driving and not following the traffic signals leading to accidents. This problem is rising due to the behavior of drivers and the absence of proper infrastructure to support this rise in the vehicles and to resolve this proper training of driver and better infrastructure planning is required.

4. Methodology

Six Sigma is gaining popularity in all areas, which tends to improve the process, services, and quality. Six Sigma methodologies are all about improving the process, products and service quality. It consists of DMAIC approach which is a systematic ladder from defines till improvement and control of the process. DMAIC is a guide that has some tools in it to rectify the problems [3]



Fig 1*:* DMAIC Cycle

4.1. Define

Before finding the solution to any problem, it is necessary to determine what our problem is. It is this step which helps us in it. It is the most time taking and even one of the hardest phases of DMAIC because it gives us the exact area which is erroneous [4].For our study, the team formation and other details are mentioned in the project charter (Table II). The objective of the define phase is to define the present problems in terms of fatal road accidents which are increasing at an alarming rate due to traffic congestion. The traffic jams increase the idle time and drivers want to reach their destination at a defined time for which the drivers either speed up their vehicle or go on the wrong way.

Table 2: Project Charter

Project title	DMAIC Approach for Road Wellbeing: A Case Study
Place	Ghaziabad, Uttar Pradesh
Team Member (faculty)	Ravi Shankar Raman
Students	Himanshu Chauhan and Ankit Negi
Project Period	September, 2017
Type of Project	Road safety
Nature of Project	Identifying the idle time, junction responsible for it and suggesting possible remedies.

4.2. Measure

After defining the problem, it becomes necessary to quantify it. It is the role of this phase to determine the amount of loss. Critical areas decided in define phase are now measured in this phase to know the contribution of it in the whole process.

Data is collected in two ways,

1. Continuous data: which is expressed in units of physical property such as length, diameter, temperature etc. and resource data are like money and time.
2. Discrete data: these are the data regarding characteristic such as color, odor, count data like yes/ no, pass/fail etc.

Generally, the data is converted into discrete data. For road case study type projects, we generally measure the data in continuous form like in terms of time and distance [1].

Table 3: Idle Time Calculation

Day	**Distance (KM)**	**Average time to reach (in min)**	**Average idle time (in min)**	**Idle time %**
1	13	30	9.28	30.93333
2	13	26	4.08	15.69231
3	13	41	18.98	46.29268
4	13	24	3.5	14.58333
5	13	26	4.68	18
6	13	28	6.77	24.17857
7	13	24	3.75	15.625
8	13	34	13.16	38.70588

9	13	21	2.53	12.04762
10	13	24	3.12	13
11	13	33	10.57	32.0303
12	13	29	7.08	24.41379
13	13	33	11	33.33333
14	13	21	2.416	11.50476

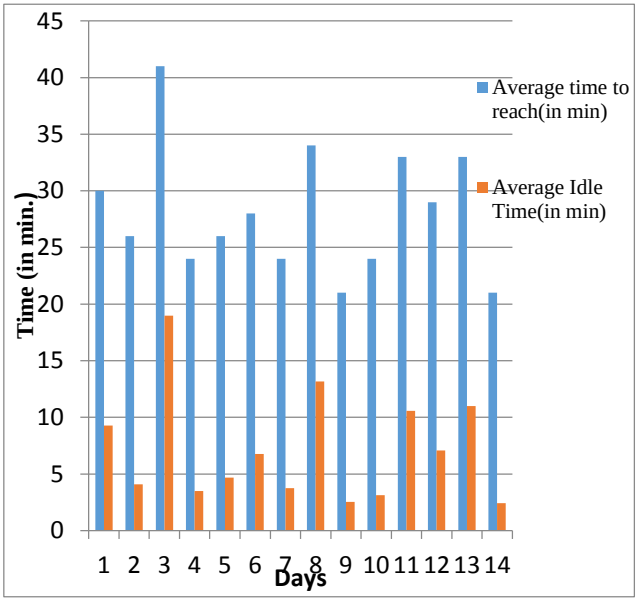


Fig. 2: Travelling and Idle Time

4.3. Analyze

In analyze phase the collected data is arranged and then analyzed to find out major defects among all other defects. Initially the root problem is found out using the Fishbone diagram as shown by Fig. 3 and to identify the critical factors 80/20 principle is used according to which 80% problems can be rectified by controlling 20% causes [2]. In our study we analyzed the average idle time at 5 critical junctions. From our Pareto chart (Fig. 4), for critical junctions it became clear that junction J3 and J2 are causing the most problems and must focus on them to improve the current scenario.

4.4. Improve

After the analysis of data and pointing out the major problems, some amendments are done in the process.

Suggestions for improved Road Safety:-

- The licensing system must be made strict by making the evaluation process more practical and canceling the license of those who are involved in some kind of illegal practices like – drunken driving, jumping traffic signals, driving wrong way etc.
- The continuous & rapid improvement of the infrastructure is required to meet up with the rising registration of the vehicle.
- There should be check post on the highway especially near the residential area so that the offenders can be caught.
- The registration of auto rickshaw must be limited and the illegal autos must be removed immediately.
- The stops for auto rickshaw must be planned and proper training must be provided to them so they can follow safety regulations.
- The load limit of the heavy vehicle must be watched over.

Suggested changes for the Junction J3 and J2

- The height of the divider must be increased and the broken divider must be repaired.
- The width of the road must be increased.
- Traffic signals must be installed.
- Construction of a new bridge over Hindon River to handle the increased traffic.
- Underpasses must be constructed.

4.5. Control

All the suggested changes must be taken into consideration and the process of widening of the road and the flyovers must be made periodic so that it can meet up with the rising demand.
If the widening of the road was done beforehand as the increase of vehicles was observed this problem would not have occurred. Therefore, the continuous improvement is necessary. Moreover, a petrol team must be formed to solve the issues like brake down of heavy trucks, which hinder the traffic for an indefinite amount of time. Helpline number must be displayed after regular interval beside the road so that the commuter can communicate with these authorities and report such cases. This is a necessary action to solve the problems before they become a major issue.

5. Conclusion

People usually claim the lack of infrastructure for traffic jam but they are equally responsible for it. The road wellbeing is an important issue as the number of accidents is on the rise and the negative impact of this on the economy, environment and the health of the people cannot be ignored. In our study commuters are wasting up to 23% of their total time on traffic congestion. This causes economic loss in the region as the people are spending this time being unproductive and people usually try to compensate this idle time by rash driving and going on the wrong way leading to accidents. People do not consider that their action like going on the wrong way can cause a chain reaction for all this. If the suggested changes are made at the critical junctions that we found out using DMAIC principle, we can reduce the lead-time by 70%.

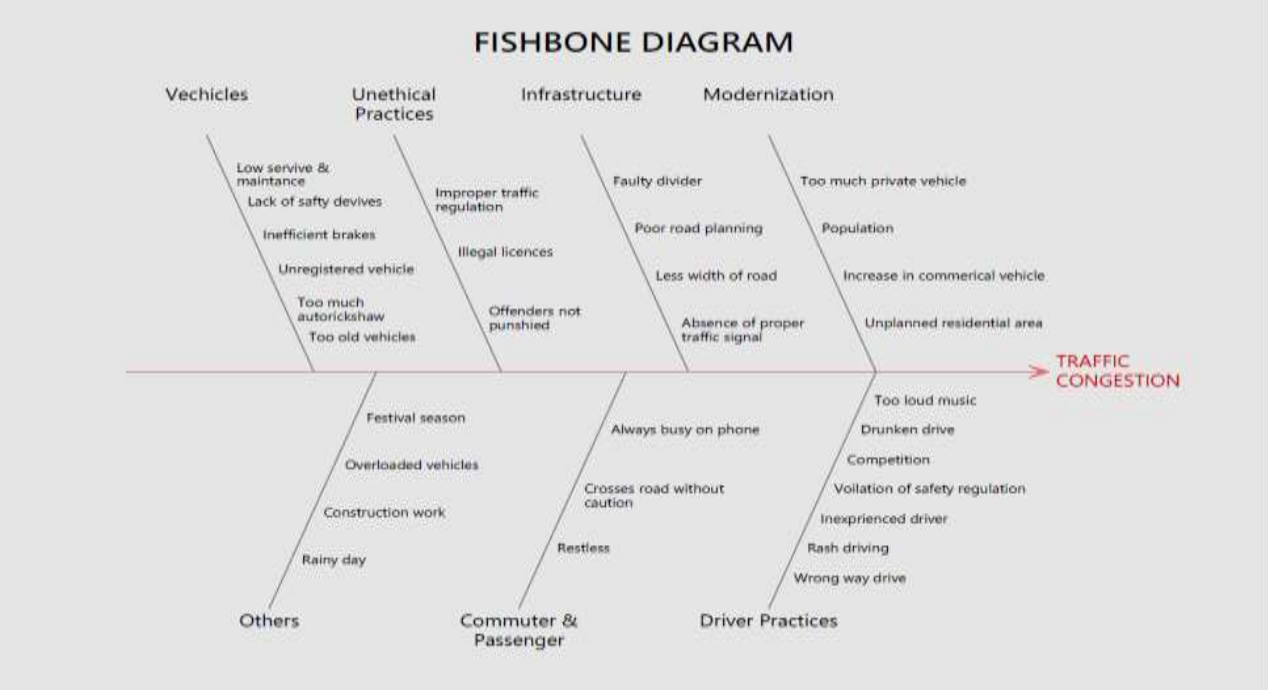


Fig.3. Fishbone Diagram – Reason for Road Accidents and Trafic Congestion

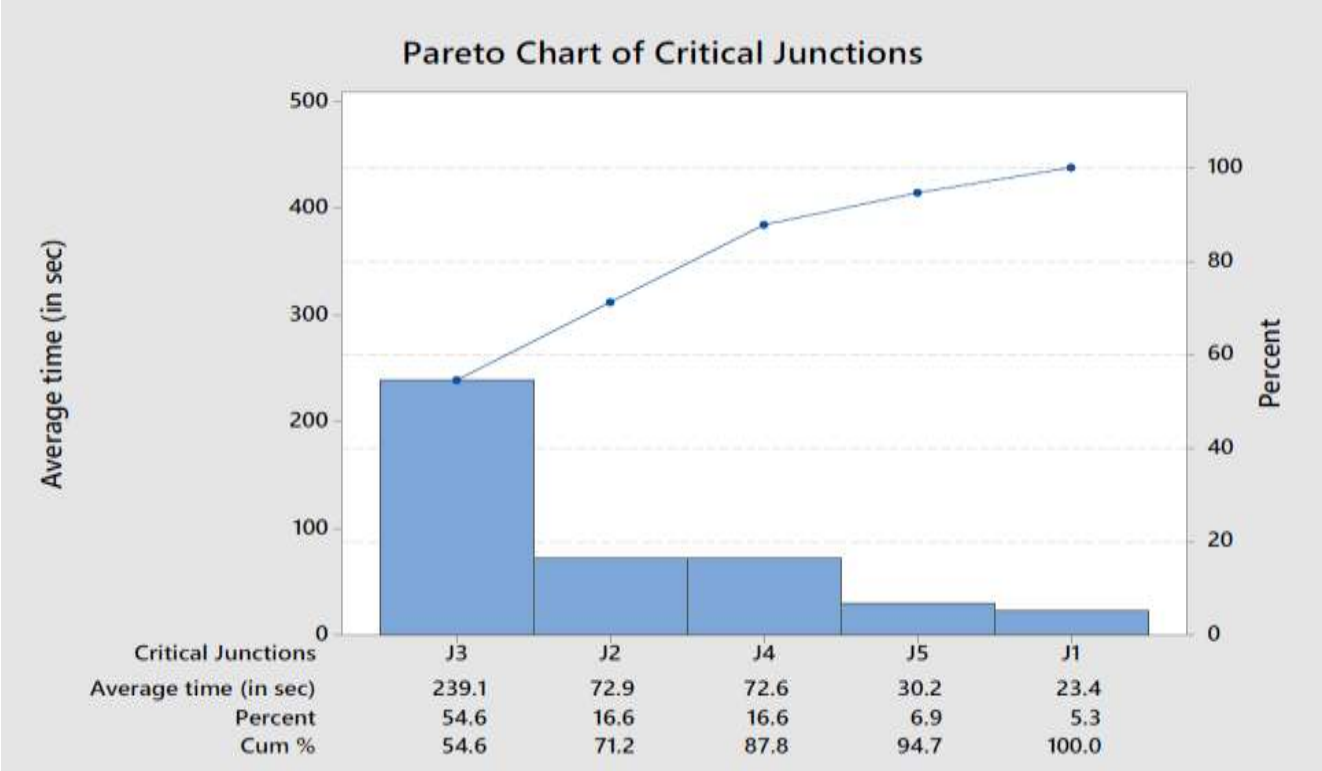


Fig.4: Pareto Diagram – Finding Critical Junctions

J1- Expo centre, sector 62, Noida, J2- Pusta Road Junction, J3-Pratap Vihar Junction, J4- Gaur city Junction, J5- Vijayanagar Junction.

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