

## **Topic: - Increase in operational efficiency of National Highways Authority of India in terms of Increase in Road Length of Highways and Traffic Management and Movement on Highways**

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### **1. Abstract**

*National Highways authority of India is the prime body responsible for construction and development of highways in India. Indian highways are important factor that are indirectly affecting the economy as maximum percent of freight and public transportation takes place by roads throughout the country and it actually gained boost in carrying more and more projects when they made transformation in PPP (Public private partnership) and Private players were directly involved in road asset management under the governance of National Highway Authority of India. So, there was various gateways through which private players could involve in road infrastructure projects and maintenance projects. These Gateways are the Financing and Operating Model proposed by NHAI. Thus, this study aims to bring out the efficient model by doing the analysis on the survey which is taken from the field professionals and their opinions. This study will bring out and analyze the opinion of the field professionals about various parameters that are indicating the operational efficiency of NHAI. And it is being found that Hybrid Annuity Model is efficient model and relationship was found with the quality of roads and it actually increased. The research also revolves around the traffic movement survey done by NHAI on the roads. That is the important factor which is considered for upgrading the roads and traffic decongestion planning by authority of highways.*

**Key words:** - Operational efficiency, Financing and Operating Model, Public Private partnership

### **2. INTRODUCTION**

National Highways are the network of the roads for interstate movement of passengers and goods. These roads connect with major cities districts and states where heavy traffic movement of passengers and goods takes place. They traverse the length and width of the country connecting the National and State capitals, major ports and rail junctions and link up with border roads and foreign highways. NHAI is the prime body responsible for upgradation, development, and maintenance of National Highways in the Country aims for the last mile connectivity throughout the country so in this process of developing highways throughout the country huge investments and resources are required engineering resources, capital resources etc so NHAI is responsible for managing this resources in the most efficient manner to provide the best road services to the public. In order to this NHAI invites private players in road asset management where the project is decided and the bidding is done for any type of road infrastructure projects so the gateway to enter the road asset management sector for the private players is the type of Financing and Operating Models through which the project and contract is being given. So, this research brings out the analysis of the survey of field professionals and the analysis suggest the effective financing and operating model according to the analysis of the primary data. The following are the type of the models.

#### **FINANCING AND OPERATING MODELS USED**

##### **BOT(TOLL):**

It is a build operate and transfer model where the whole investment of the complete road project is to be met by private players where the firm can use the bank loan or through equity or the mix of both and the revenue they will get will be the toll collections so here the right of the toll collection is with the private

firm a capital grant up to 40% is provided by NHAI that could increase the viability. Here the maintenance of the roads is to be carried out by the particular firm and the project could be transferred back to authority after a specific period generally after 30 years.

**BOT(ANNUITY):**

Here also the total upfront cost is to be met by private organization where they can generate the capital through loans or equity or proportionate mix of both. But here the toll collection right rests with the authority where the payments will be done to private players by the authority on phase by phase basis where the project is divided into various phases on completion of each phase they will receive their payments so the commercial risk is transferred to the authority here.

**EPC:**

It is the traditional model where there is fixed term of project and fixed cost. The total upfront cost of the project is borne by the government and toll collection rights also rests with the authority so here the just a contracting of the project is done to private players where the just play a part to build and maintain the road and the whole cost is to be met by the authority.

**HAM:**

In Hybrid Annuity Model there is better risk distribution between private organization and authority and here the 40% of the project cost is to be met by authority in five installments according to the phase completion and rest 60% is to be met by Private organization. Here toll collection rights rest with the authority where and annuities will be paid by the authority to the organization till the end of the concession period. So here also commercial risk gets transferred to the authority and there is shared investment in the project by the authority and private players.

**3. Research gap**

All the research paper stated that there was no such specific analysis done on preferred Operating and Financing models used and there was no such survey analysis done on operational efficiency of NHAI on quality and maintenance of highways. Neither there was any focused survey on challenges faced by NHAI in the recent years.

So, there was no recent survey being done on operating and financing model that is more preferred. There was no survey done on projects completing within deadlines in the recent years according to the zonal location.

There was no such survey or analysis being done on how NHAI is considering the traffic movements on roads whether it is passenger traffic or goods traffic and how they are classifying that traffic and analysis being done before carrying out any Road infrastructure project.

So, this research will bring out the analysis of the survey conducted that will give us the preferred model could be used and analysis would also give us the deep insights on the satisfaction level on quality of roads and maintenance activities that are performed.

It will also give us the current challenges NHAI is facing.

**4. Research objective**

To identify the best preferred financing and operating model that could be used to increase the quality of roads.

To find out traffic survey being done by NHAI before implementation of any road infrastructure projects or maintenance and upgradation of road projects.

To find out the current challenges NHAI is facing and how the preferred model could be the best fit for current situation.

## 5. Hypothesis

**Null Hypothesis (H0):** - There is no Increase in operational efficiency of National Highway Authority of India due to implementation of PPP HAM (Hybrid Annuity Model).

**Alternate Hypothesis (H1):** - There is Increase in operational efficiency of National Highway Authority of India due to implementation of PPP HAM (Hybrid Annuity Model).

## 6. Literature review

### **BKC Committee report (2009):**

In this report of BKC Committee (Year 2009) involves the recommendation that has been given to National Highway Authority of India that carrying out the road project with all the three models that are BOT toll, BOT Annuity and EPC Should work concurrently rather than Vertically. It has given the operations of every model that could help me in analysis of every model in my project

### **Nested Frame work for Transparency in PPP of Highway development Project in India (2013):**

*Paper authored by Chandrima Mukhopadhyay* gives deep insights of Transparency in PPP projects in India. It offers framework of transparency to get the view of decision making in mega projects. It suggests purpose of transparency would have better served if direction of disclosure and time would have altered. It gives me the insights regarding PPP projects and would help me to get how government bridge this gap by introducing Hybrid Annuity Model.

### **National Highway Authority of India Work Manual 2006:**

*This Manual of 2006* states all about the guidelines about procurement of work, Consultancy services and Construction this manual embraces tender qualification, Quality Assurance, PPP projects, Corridor Management and Land acquisition. It clarified me about their procedure in 2006 how their operations were carried and I could find out what they were lacking at that phase.

### **Basic Road Statistic of India (2016-2017).**

*In Report of May 2017* Ministry of Road Transport and Highways has highlighted the drastic increase in the road length of highways and detailed steps taken for innovative project financing and leveraging both private and public funding, smooth functioning of land acquisition process. This report gives light on how they introduced new ways of funding and indulge into a tendering which was used In Hybrid Annuity Model of highway project so it has given me the Projects data using this new technique that would be helpful for my Research.

### **National Highway Authority of India Annual Report (2017-2018):**

*This report of 2017-18* informs about The Bharatmala Pariyojna project under which 34800 km of National Highways are to be upgraded in phase1. It states that Bharatmalapariyojna promises to optimise the efficiency of road traffic movement across the country by reducing infrastructural gap. The main focus of this report is on providing efficient transport and reducing the cost of logistics by bringing out last mile connectivity. This report gives insight of Upgradation of State highways to National Highways and how they are introducing new ways of procurement and tendering which gives the insight for my research.

**Traffic flow Characteristics for Multilane Highways in India (2016):**

*Paper authored by Jain. K, Jain S.S and Singh M*

Gives light on the density occupancy of different type of vehicles with broad range of different spectrum of speed and their movement analysis on road. The objective of this study is to estimate basic traffic flow parameters for six lane divided traffic stream and to develop speed flow equation for different type of vehicle on six lane highway. It would help me to analyze traffic flow on highways and How NHAI is analyzing it and What Solutions they are coming up with.

**7. Research methodology****1. Research Design**

The purpose of this research is to find the best model which has contributed in the achieving NHAI efficiency in terms of increase in the road length of highways. Research shows insights various models that NHAI used.

**2. Target Population of study.**

Questionnaire prepared for study was exposed to 80+ professionals and students from civil engineering background and those who are directly or indirectly engaged in road infrastructure projects.

**3. Sampling method**

Census Sampling (Civil Engineering domain)

**4. Method of Data analysis:**

Research was quantitative in nature where categorical and scaled questions were asked those which fulfilled the objective of the research such questions responses were taken on SPSS as the where categorical in nature therefore a chi square relation test and crosstabulation was performed and got the results.

**5. Type and Source of data:**

Type of data is primary and secondary both. Opinion from the Civil professionals will be considered as primary data. Data taken from the NHAI official website and PPP India projects Is the secondary data.

**6. Method of Data collection**

Close ended Questionnaire

## 8.Data analysis

Table: Road Network in Km

(000) Km's	1991	2001	2011	2015	2017
<b>Total Road Network</b>	<b>2327</b>	<b>3374</b>	<b>4677</b>	<b>5472</b>	<b>5898</b>
National Highways	34	58	71	98	114
State Highways	127	132	164	167	175
District Roads	509	736	999	1101	586
Rural Roads	1260	1972	2750	3337	4167
Urban Roads	187	252	412	467	526
Project Roads	210	224	282	302	329
<b>Composition of National Highways by Width (%)</b>					
Single lane		38.9	24.1	31.7	25.3
Double lane		58.9	51.7	46.6	51.6
Multi lane		2.2	24.2	21.6	23.1
<b>Composition of State Highways by Width (%)</b>					
Single lane		74.2	60.1	51.5	
Double lane		24.5	35.9	42.3	
Multi lane		1.3	4.1	6.2	

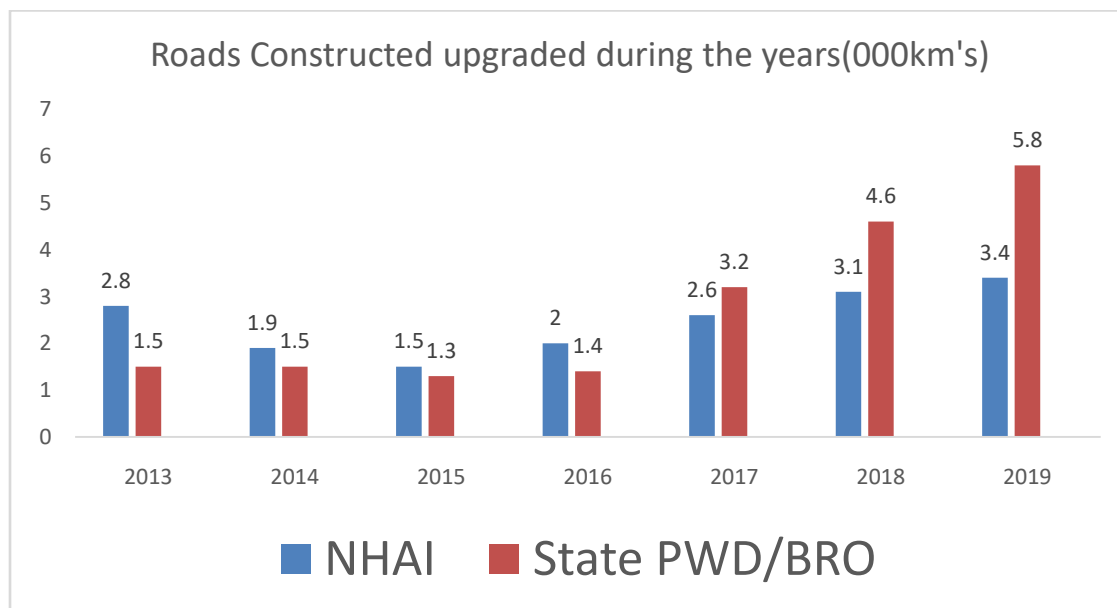


Fig: Graph of Road constructed in km by NHAI and State PWD/BRO

Source: Ministry of Road Transport and Highways

From the above table it is clear that NHAI has increased the road network in the recent years. Also, from the data set it can be seen that they have worked in widening of roads therefore we can see the growth in double lanes and multi lane categories from the table.

Data analysis of the survey conducted:

The survey was made and questionnaire was circulated to all field professionals and analysis of

responses is done in the SPSS software. As both variables are independent and dependent variables are both categorical variables. So crosstabulation and chi square test of relation is used to find out if any relationship established between the two variables. And the frequency tables were used to find out the satisfaction level for maintenance and upgradation activities.

At first data reliability and validity test was performed and it was found that data is Reliable and Valid for the further test to be performed:

### Reliability Test:

Table: Reliability statistics.

Case Processing Summary				Reliability Statistics	
		N	%	Cronbach's Alpha	N of Items
Cases	Valid	101	99.0	.719	8
	Exclude	1	1.0		
	d <sup>a</sup>				
	Total	102	100.0		

a. Listwise deletion based on all variables in the procedure.

As Cronbach's alpha value here is greater than 0.7 therefore the data set is well accepted and fit for further analysis to be carried out.

### Validity Test:

Table: Validity: KMO and Bartlett's table

KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.616
Bartlett's Test of Sphericity	Approx. Chi-Square	140.023	
	df	21	
	Sig.	.000	

From the above table it is clear that as KMO value is 0.616 that is acceptable and Significance value is less than 0.05 therefore Data is well validated for further analysis to be carried out.

Source: SPSS data analysis of the responses.

- Cross tab and chi square test between quality of roads and financing and operating model preferred.

Table: Crosstab table between quality of Highways and model preferred

Count		What should be the better option to attract more Private players				Total
		EPC	BOT(Toll)	BOT(Annuity)	HAM	
What do you think about the quality of Highways being built in the recent years?	Bad	0	1	0	0	1
	Poor	1	1	1	0	3
	Moderate	13	16	3	11	43
	Very Good	7	6	8	29	50
	Excellent	1	3	1	0	5
Total		22	27	13	40	102

Table: Chi square test between quality of Highways and financing and operating model preferred

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.223 <sup>a</sup>	12	.010
Likelihood Ratio	29.029	12	.004
Linear-by-Linear Association	6.289	1	.012
N of Valid Cases	102		

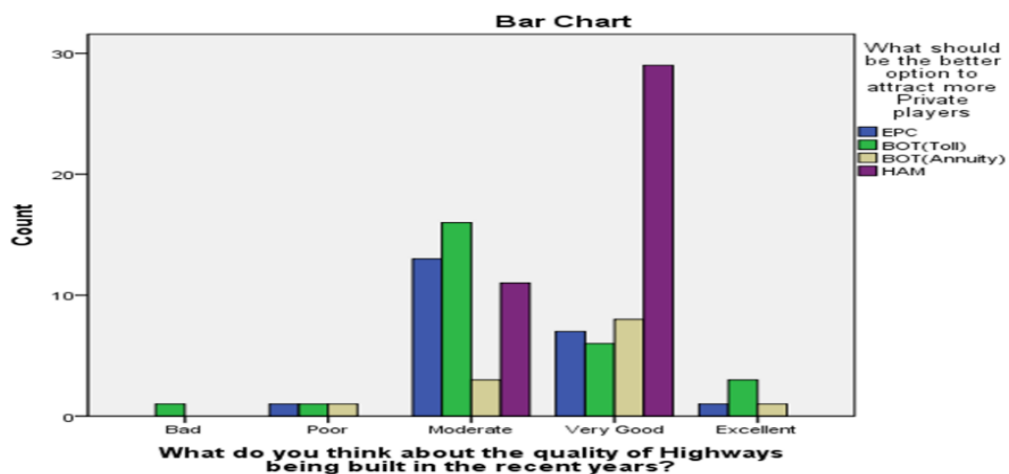


Fig: Bar graph showing quality of highways and better option that is financing and operating models preferred for attracting private players in road asset management.

Interpretation: As we can see in chi square table the significance value that is p value is less than 0.05 which shows dependency and relationship between the two variables.

As here we can see the null hypothesis is getting rejected.

Now crosstab shows frequency is quite good in case of HAM model with respect to quality of highways in very good category which resembles that HAM financing and operating model is the best fit when it comes to quality of highways.

When we look at the graph it also shows HAM model showing result with a good quality of highways from this it is very evident that HAM model is the best preferred model.

- Crosstab and chi-square test between involvement of private players and financing and operating models preferred.

Table: Cross tab table for involvement of private players and financing and operating models Preferred.

Count		What should be the better option to attract more Private players				Total
		EPC	BOT(Toll)	BOT(Annui ty)	HAM	
Should NHAI continue to entertain involvement of Private players in Road Asset Management	Yes	11	25	11	38	85
	No	11	2	2	2	17
Total		22	27	13	40	102

Table: Chi square test

between involvement of private players and financing and operating model preferred.

#### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.202 <sup>a</sup>	3	.000
Likelihood Ratio	20.114	3	.000
Linear-by-Linear Association	13.877	1	.000
N of Valid Cases	102		

a. 3 cells (37.5%) have expected count less than 5. The minimum expected count is 2.17.



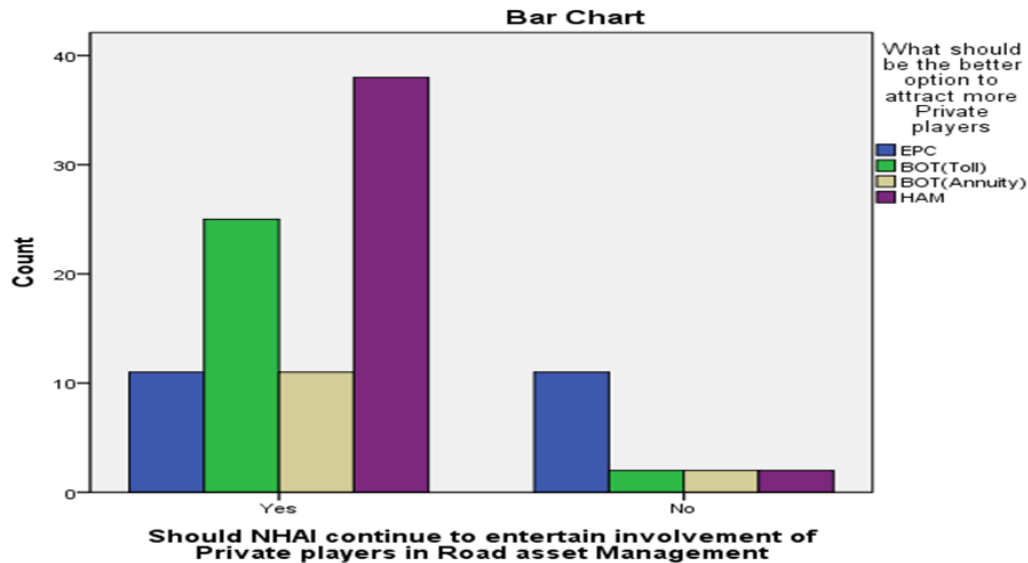


Fig: Bar graph between involvement of private players and better financing and operating model option could be used to attract more private players.

Interpretation: As we can see in chi square table the significance value that is p value is less than 0.05 which shows dependency and relationship between the two variables.

As here we can see the null hypothesis is getting rejected.

Now crosstab shows that if we are involving private players in road asset management then Hybrid Annuity Model is the best preferred model.

Now the graph clarifies the situation very well here it can be seen that frequency that private players should be involved is high and in that case HAM model is the preferred model that can be used for contracting the road projects.

- Cross tab and chi square test between presence of National Highway and quality of Highways.

Table: Cross tab table between two variables that is presence of national highway and quality of Highway in that region.

Count		What do you think about the quality of Highways being built in the recent years?					Total
		Bad	Poor	Moderate	Very Good	Excellent	
Is there any National Highway or Expressway Passing through your city or nearby from your city	Yes	0	3	42	50	5	100
	No	1	0	1	0	0	2
Total		1	3	43	50	5	102

Table: Chi square test table between presence of National Highway and quality of Highway in that Region.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	51.190 <sup>a</sup>	4	.000
Likelihood Ratio	10.189	4	.037
Linear-by-Linear Association	10.311	1	.001
N of Valid Cases	102		

a. 8 cells (80.0%) have expected count less than 5. The minimum expected count is .02.

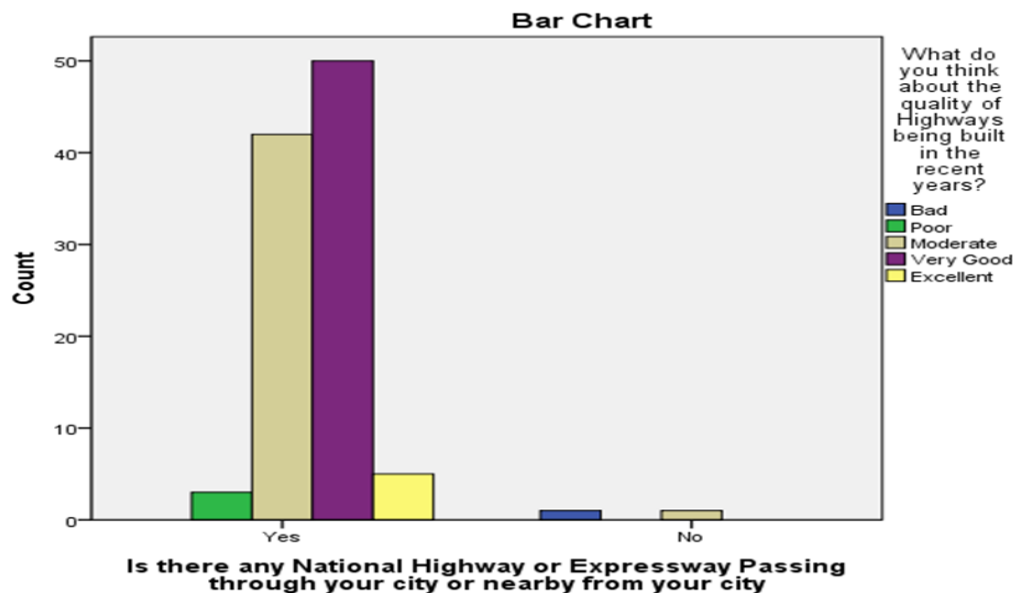


Fig: Bar graph between Presence of National Highway in that region and Quality of Highway.

Interpretation: As we can see in chi square table the significance value that is p value is less than 0.05 which shows dependency and relationship between the two variables.

As here we can see the null hypothesis is getting rejected.

Now crosstab shows very high frequency of presence of National highways in the respondent regions and quality is moderate and good which shows that NHAI is working towards quality of roads in the recent years which was not the case before.

The bar graph shows the same that quality is quite moderate and good where there is presence of NH . here I am adding a disclaimer that this is the situation of very recent years.

- Correlation test between projects completed within deadlines and their quality.

Table: Correlation table justifying Projects completed within Deadlines and their Quality.

Correlations			
		What do you think about the quality of Highways being built in the recent years?	How do you rate NHAI in completing the major projects in your state within deadlines in recent years
What do you think about the quality of Highways being built in the recent years?	Pearson Correlation	1	.289**
	Sig. (2-tailed)		.003
	N	102	101
How do you rate NHAI in completing the major projects in your state within deadlines in recent years	Pearson Correlation	.289**	1
	Sig. (2-tailed)	.003	
	N	101	101

\*\* . Correlation is significant at the 0.01 level (2-tailed)

Interpretation: As we can see here the significance value is less than 0.05 therefore giving us significant relationship between the projects completed within deadlines and the quality of roads. That tells us the quality of the roads are quite good if they follow the deadline and that is what happening many projects got stalled due to investment problem or improper financing and operating models used so this affected the quality of road. So, there should be a proper planning and tracking of projects which is being properly done by Authority in recent years in their project planning interface developed by deloitte India where they can track a project and ensure the completion of phases within time so that it could be good for private contractors also and cost do not over run which minimize the probability of project getting stalled.

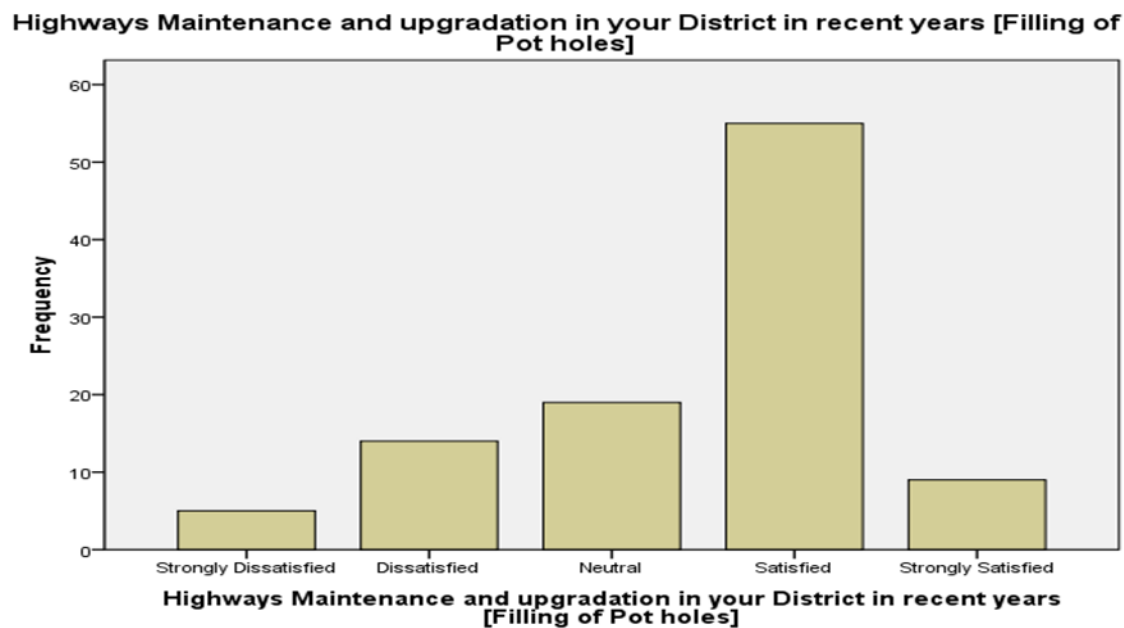


Fig: Highway Maintenance activity (Filling of pot holes)

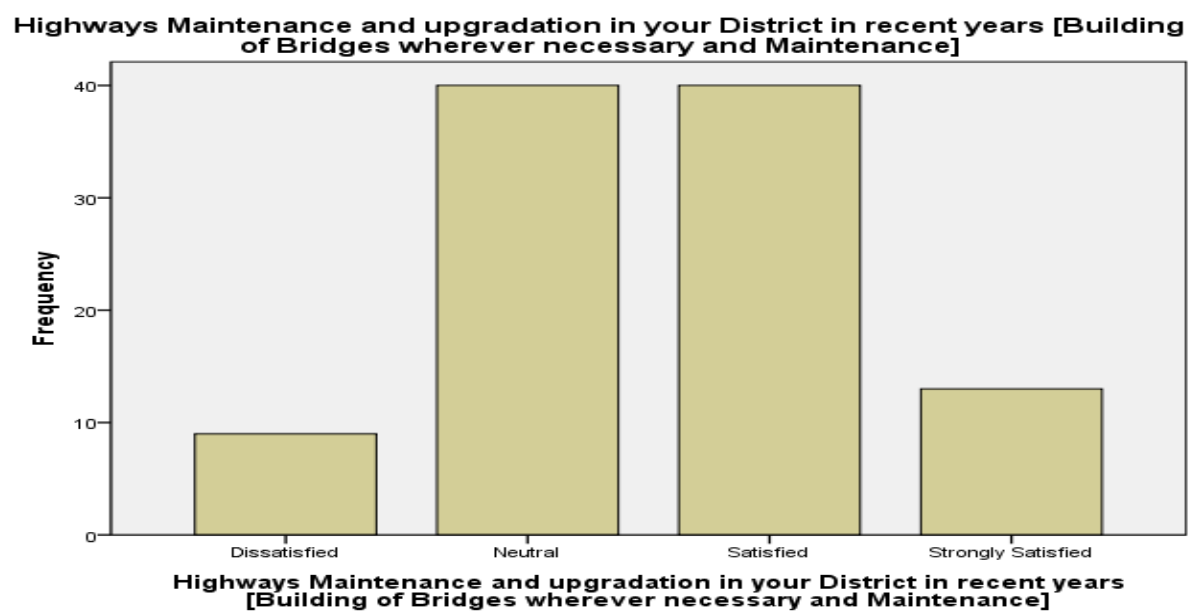


Fig: Highway Maintenance activity (Building of bridges and maintenance)

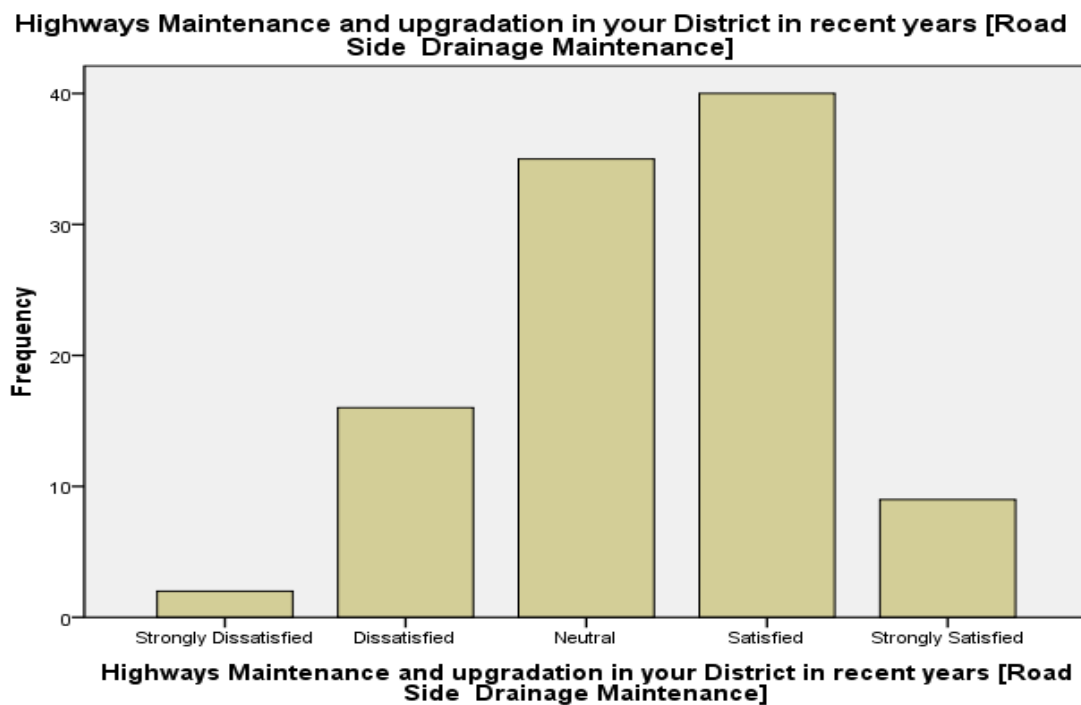


Fig: Highway Maintenance activity (Road side Drainage maintenance)

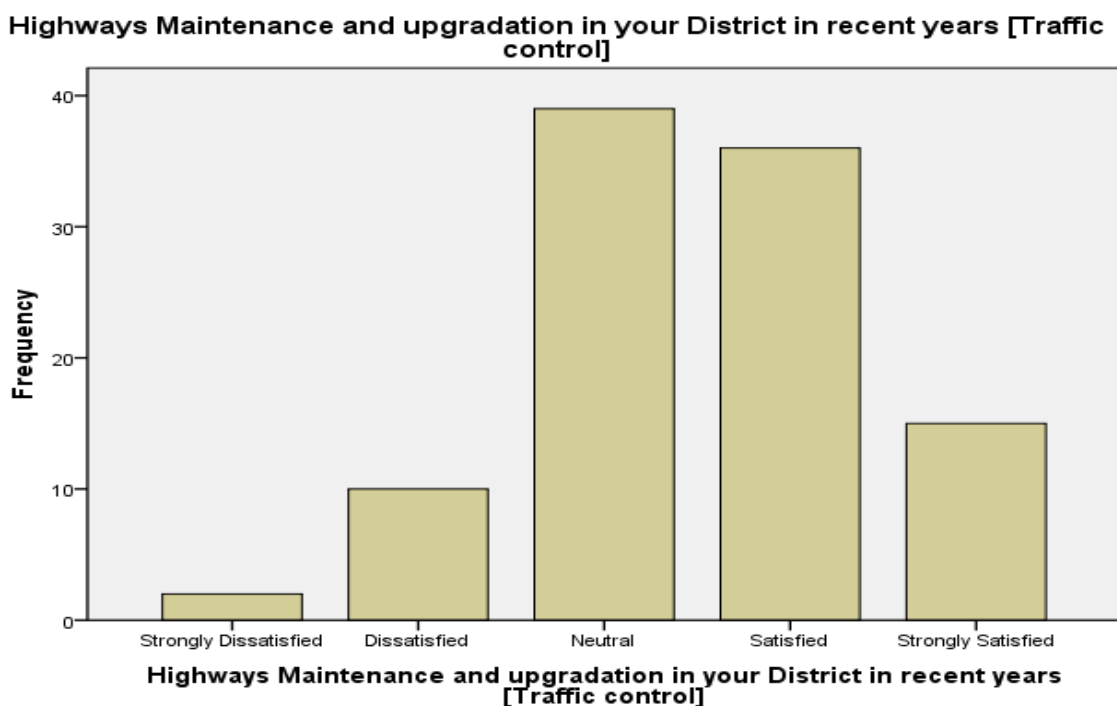


Fig: Highway Maintenance activity (Traffic control)

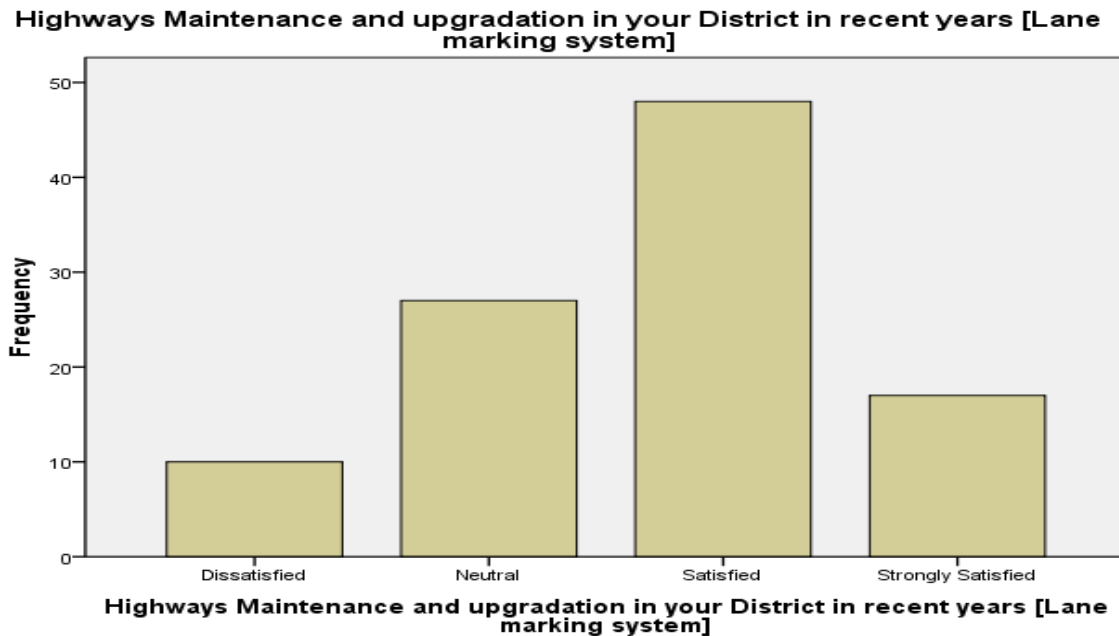


Fig: Highway Maintenance activity (Lane marking)

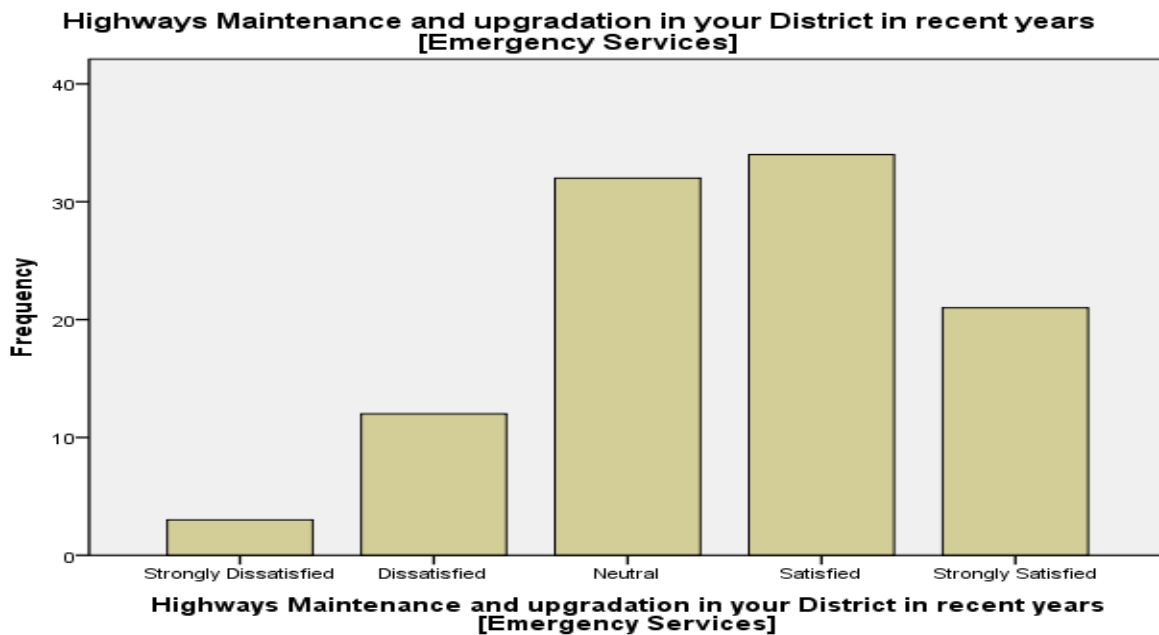


Fig: Highway Maintenance activity (Emergency Services)

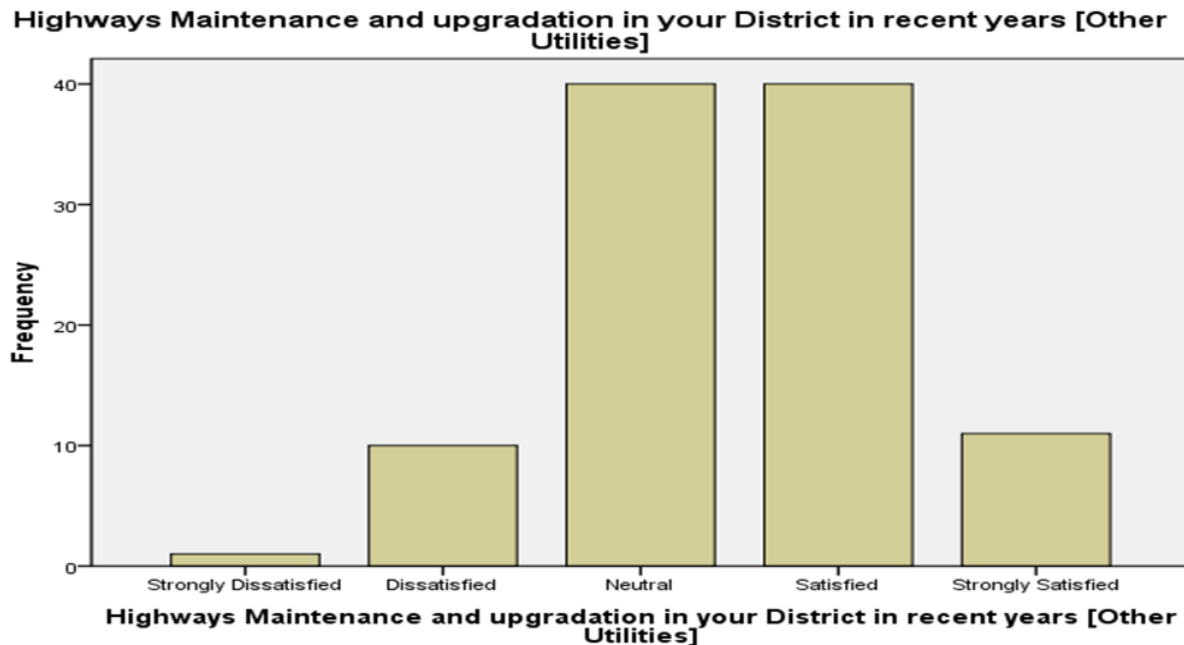


Fig: Highway Maintenance activity (Other utilities)

#### Interpretation:

It is seen that from the above graphs which is obtained from the analysis of the survey conducted that authority has improved the maintenance and operational activities in the recent year. Now there is specific model that is O& M model that is operation and maintenance model in which the project is contracted to any private infra builder to upgrade the road which is managed by the authority for e.g. EPC projects that are still owned by authority in the recent years it was seen that as Private players are participating the road asset management with the project contracted through BOT , TOT, HAM, as Maintenance part has to be managed by the infra builders there has been improvisation in maintenance activities and due to Bharatmala Pariyojna as roads are widened into multi lanes and upgraded so there is improvement in the upgradation activities.

#### Finding on Secondary Data Survey:

There is increase in sanctioning of projects through HAM model by Authority in recent years it was launched in 2016

Since HAM has launched near about 40-50% of the project are sanctioned through Hybrid Annuity Model.

Projects awarded: 119

Total length: 6670 km

According to the CRISIL report a good 70-75% of financial closure with a turnover of 1500 crore was obtained by large developers.

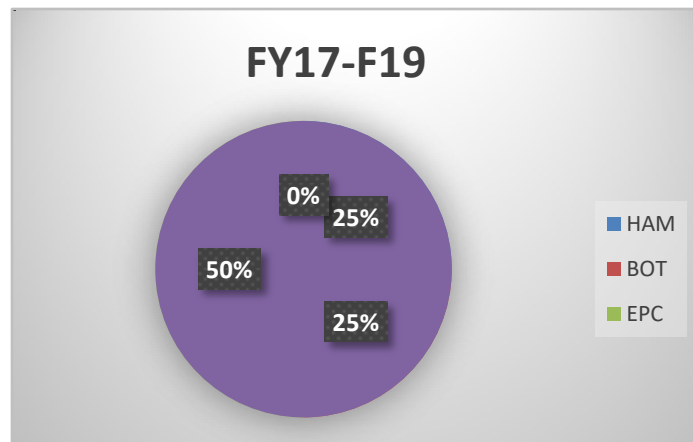


Fig: Pie chart for the project awarded through various Financing and Operating Model in FY17-19

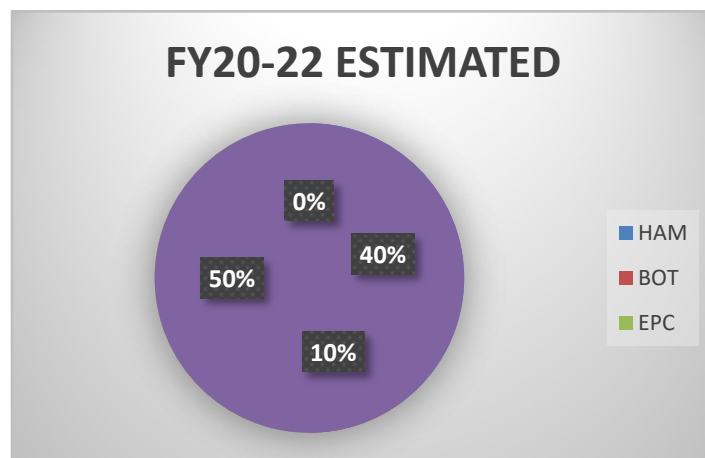


Fig: Pie chart for the project awarded through various Financing and Operating Model in FY20-22 This is Estimation.

*Source: Crisil Report 2019*

Interpretation: As it can be seen from the CRISIL report that Most projects could get awarded by HAM model but there is some concern because some small players struggled here the only reason was they faced investment issue as seen in 2019 with economy struggling banks where not invested to lending infra loans and there was issue in debt to equity. Banks wants small players to bring higher amount of equity capital to increase the viability so they didn't get that investment. Big players earned revenue but small players struggled to do so. There should be change in ratio for small players so they can play a big role in road asset management.

And there was also delays in appointed dates which could increase the risk of termination.



## 9. Findings:

- It is been found from the data that according to the analysis done on categorical variables and cross tabulation and chi square test was applied and p value was less than 0.05 in the analysis of two variables that is quality of roads and models preferred so it was very clear that Hybrid annuity model was the most preferred model and quality is also good in that case we can also see that there is relationship between quality of roads and financing and operating models preferred so the null hypothesis rejected.
- Analysis was done on whether the private players should be involved in the road asset management and financing and operating models that is preferred and crosstabulation test and chi square test of relation was also performed and it was clear that involvement of private players was preferred and Hybrid annuity model was the most preferred for the private players involvement as the p value was found to be less than 0.05 and the relationship was established.
- As one of the variable was presence of national highway in their districts and cross tabulation test was done with another variable quality of the roads and chi square test was also done so it was found that p value is less than 0.05 and relationship is established and crosstab showed that the quality is moderate and good if there is the presence of National Highway in that particular region.
- As it is seen in the frequency table and bar graphs we can see that NHAI has improvised its national highways maintenance and upgradation in the recent years as there were different parameters that was stated that are various maintenance activities that are listed and people are satisfied with all the parameters in the recent years.
- Though the model is preferred model there are some loopholes according to the above analysis where some private players were not able to achieve financial closures.

## Traffic Analysis on Highways:

Major causes of traffic congestion on Highways is given below:

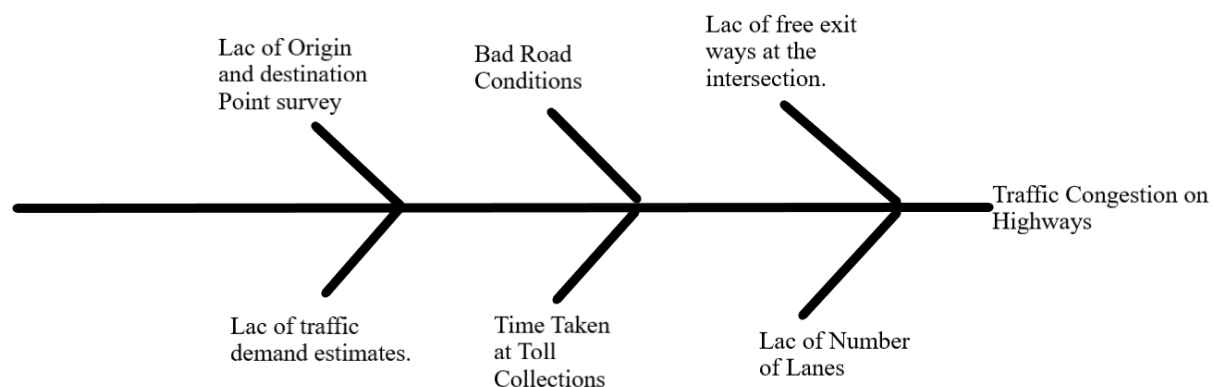


Fig: Root cause analysis of traffic congestion on Highways.

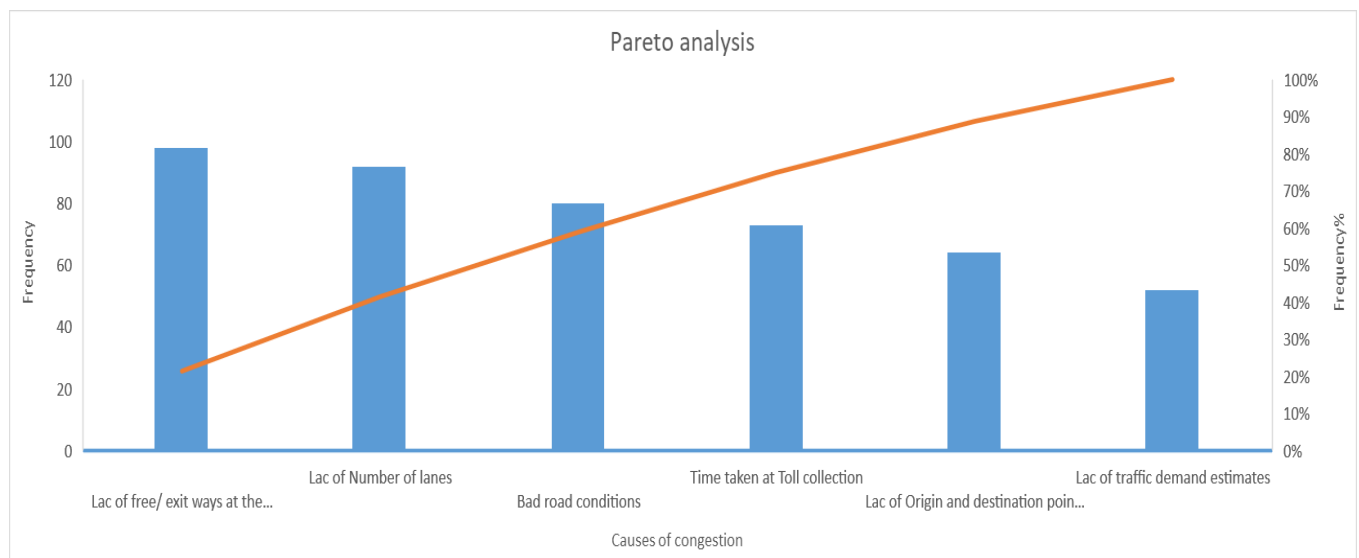


Fig: Pareto analysis of traffic congestion on Highways

*Source: Development of road congestion index paper  
Authored by Geetanjali chandem, Yanchen*

Interpretation: It is being found that Major problem is at lac of free exit ways at the intersection and another major problem is Lac of number of lanes and Bad roads condition. Now the frequency data was collected through secondary research by average weighing and then it was analyzed so to tackle this problem a good traffic survey is needed and therefore NHAI came up with a good traffic survey module which can solve the problems.

Traffic survey By IHMCL Indian Highway Management Company Ltd through ATCC (Automatic traffic counter and Classifier) Helped NHAI is Counterfeiting the problems of traffic congestion. Now this survey is classified into various stages So the various stages are:

1. Classified traffic volume count survey:

So primary aim of the survey is to classify the traffic according to type and category there are basically two types motorised traffic and non-motorised traffic. Then it is divided into various types two wheelers, three wheelers, four wheelers, and then again it is classified into passenger car, commercial vehicle, public transport and heavy-duty trucks are classified according to no of axles and MAV also articulated and semi articulated. Now this data is to be calculated daily and analysed and then average weekly traffic is plotted and considering that Annual Average Daily traffic is calculated.

2. Origin and Destination survey:

Now as the name here suggest the origin and destination is decide along the stretch it is decided on the basis of intersection in Town or any other Highway so a both direction O & D commodity movement is studied. Matrices of the Trip is to be formed according to the vehicle type and the pattern is analysed where the commodity data can be further used to carry out traffic demand estimates.

3. Turning Movement Survey:

This survey is carried out at major and minor intersections along the Highways where the survey is carried out in peak hours the intersection is studied where the pattern of commodity moving towards the intersection and after that where it classify the movement according to the vehicle types and metric is drawn for that and analysed for need of any particular road infrastructure like flyover, underpass, grade separated lane in intersection. The requirement of the above infrastructure project is studied here by analysing the traffic survey at the intersections.

4. Axle Load surveys:

This is the survey which is done on heavy duty transport or commercial vehicles especially for trucks, buses also where they are weighed now here the point/place where to do this is decided with NHAI. Loading behaviour is studied here this survey could be done at particular survey station where VDF (Vehicle Damage factor) is calculated which is to be below national average. Now this survey could be used for bridges and their load carrying capacity. So here this survey tells us whether there is a need for reconstructing it or not. And it also used to decide pavements to be made for engineering aspect.

5. Speed delay survey:

This survey is done across the particular stretch of the Highway where the vehicle speed is surveyed along the highway. Average speed and time taken to cover that particular stretch is studied and if there is delay or if it crosses the upper limit on the control chart then that special cause is studied so that solutions could be implemented for smooth flow.

Traffic Demand estimates:

This estimate is very important because this give us the conclusion that whether there is a need of road infra project there and type of the project. So, the commodity survey from both the direction of origin and destination provides the input to this survey. The demand estimates and establish possible traffic growth rates in respect of all categories of vehicles, taking into account the past trends and analysis, annual population and real per capita growth rate, income relation with elasticity of transport demand and estimated annual production increase, the projection of vehicle manufacturing industry, other modes of transports and their development plan is also studied while calculating the traffic demand estimate. Now this is to be done to for 30 years after the project is constructed as private players are investing lot of capital in it so revenue should be generated in form of toll collections and therefore traffic forecast need to be done properly by considering overall future projects because these will give the assurance to the private players and investors to invest in the highway projects so it should consider all the possibility optimistic, pessimistic and most likely.

So, to conduct the above surveys various survey stations are established along the stretch and equipped with various survey instruments like pneumatic tube detector, Inductive detector loop, Video image detector, Infrared sensor. So these devices bring data and that is arranged and analyzed.

This survey analysis could actually help NHAI for the need and type of road infra structure project to be done now this is the just the traffic survey there are various survey followed by that that actually plays a role in decision making covering whole geographical condition and cost estimation.

**10. Suggestions:**

- As we have seen HAM model is the best preferred model here so when the government is keen to carry out the more Road infrastructure projects so they can prefer HAM model as it has better risk allotment.
- Several loop holes are also there that needs to be identified in HAM model that are still some projects are there which are stalled and many companies still did not receive financial closure so better debt equity ratio should be decided.
- Investing ratio could also be made agile where government could fund a larger part and to avoid more investment burden let private players generate the invest for smaller part considering the current situation of economy it could be a better financing option.
- There are more traffic congestion problems in Highways in India especially when it merges at the cities or passes through, so proper O & D survey could be made to analyse proper traffic management and could give the proper solution to NHAI to carry out road projects to decongest the traffic.

**11. Limitations:**

1. There was no analysis made on considering engineering challenges faced by NHAI in the recent years.
2. This research paper only limits to analysis of preferred financial and operating model could be used based on primary data obtained from the survey of field professionals so secondary data analysis for the same is not considered.
3. This research paper does not consider the current pandemic situation so survey was made considering the before pandemic situation.
4. There were no inputs taken from any Third-party firm or Organization so it was just based on the data obtained by field professionals.

**12. Conclusion:**

It is found from the data analysis of chi square state of relationship between quality of highways and models preferred it is being found that as p value is less than 0.05 therefore the null hypothesis is rejected. And it was also found the relationship between two categorical variables of involvement of private players and models preferred and it is being found that p value is again less than 0.05 states the significant relationship. Crosstabulation shows that HAM model is more preferred compare to other model and crosstabulation between presence of national highway and quality of highway suggested that quality is good and p value was less than 0.05 and crosstab showed the quality is good. There are certain loopholes also in HAM models which need to identified and corrected.

It was seen that NHAI has improved their operations and maintenance activities in the recent year. There where various causes for Traffic flow congestion and to overcome that NHAI with the help of IHMCL came up with various type of surveys based upon the nature of roads and vehicles and passengers plying on road so in-depth survey is carried out before initiating any mega project.

**13. Further Research Direction:**

- As engineering aspect is not considered and here so it can be a scope by considering the engineering challenges that could be identified and research could be done on that.
- Research could be done by considering the secondary data as well.
- Research on best feasible financial solution can also be done as we have seen still NHAI has not reached the perfect financial feasible model.

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