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A SURVEY ON ASSESSMENT OF TIME AND COST OVERRUN OF INDIAN NATIONAL HIGHWAYS PROJECT

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ABSTRACT: *An accomplishment of any construction projects is interconnected to its timely end within the specified financial plan, with the accurate quality and safe environment. Cost and time overruns have been well-known major issue in many construction industries of the developing countries like India. Media reports abound on instances of extended delays and unwarranted cost overruns in infrastructure projects. Only a small number of projects get delivered in time and within the budget. Examples of successful project implementation, like construction of the Delhi Metro Rail, are few and appear only far in between. Definitely, the problem of time and cost overruns in India is general and severe. Until now, very few empirical studies exist on the topic, even rarer are the studies based on completed projects. As a result, the extents as well as the causes behind delays and cost overruns have remained under-researched. This work is a summary of the present scenario on Indian highways including cross continental comparison with the nearby China as well as developed nations such as USA and Europe. The wide occurrence of delays in the implementation of highway projects under NHDP has necessitated the present study on time and cost overruns and this section also discusses on the research methodology adopted.*

1. INTRODUCTION

1.1 Present Scenario of Indian Highways

Over the last few years, the Indian economy has been in a stage of unparalleled growth of about 8-10 % per year, making it one of the fastest growing economies in the world. However, the thrust of economic growth could come to stop the progress of unless our country strengthens infrastructure. In this regard, roads and highways are the veins and arteries of a nation. Sustaining around 8 % rate of growth will need huge

investments in physical infrastructure such as roads and highways. Despite years of economic boom, India's infrastructure is unsteady and its manufacturing sector slow-moving. Transporting goods is expensive and slow it can take more than two weeks to move a container from Delhi to Mumbai. Investment in infrastructure in a country of India's size is relatively low (7.5% of GDP) and is much lower if we compare with some other countries in Asia. India has a road network of over 4,870,000 kilometers (2,632,000 mi) in 2017, the second largest road network in the world. At 0.66 km of roads per square kilometer of land, the quantitative density of India's road network is similar to that of the United States (0.65) and far higher than that of China (0.16) or Brazil (0.20). However, qualitatively India's roads are a mix of modern highways and narrow, unpaved roads, and are undergoing drastic improvement. As of 2008, 49 % about 2.1 million kilometers of Indian roads were paved. Adjusted for its large population, India has less than 4 kilometers of roads per 1000 people, including all its paved and unpaved roads. In terms of quality, all season, 4 or more lane highways, India has less than 0.07 kilometers of highways per 1000 people, as of 2010. These are some of the lowest road and highway densities in the world. For context, United States has 21 kilometers of roads per 1000 people, while France about 15 kilometers per 1000 people predominantly paved and high quality in both cases. In terms of all season, 4 or more lane highways, developed countries such as United States and France have a highway density per 1000 people that is over 15 times as India. The population of India is almost four times that of the United States of America (USA) and has one of the highest growth rates in the world. The existing transportation system is not adequate to sustain the current rates of economic and industrial development in the country. Demand has constantly outstripped the supply of transportation over the last fifty years. Compared to the USA, the amount of freight traffic passed by highways in India is quite deficient. The main roads in the Indian subcontinent have not kept swiftness with traffic volumes as well as in terms of quality also.

Table 1.1 Transportation sector in India in comparison with USA and European Union (EU)

Sr. No	India	USA and European union (EU)
I.	Expressway length in India is 21,181KM.	3 or 4 times More than India.
II.	Motor vehicle /1000 people are 18.	797 motor vehicles / 1000 people
III.	Trucks operate for just 20 days in a month @ speed of 250 to 300 km/day.	Trucks operate at a whopping 25 days/month covering at almost 700 to 800 km/day.
IV.	Delays at check posts, traffic police booths, toll gates etc. It is estimated that unofficial payments amounts to about 15% of total trip expenses.	In TIR Carnet System used in EU, consignments sealed at origin requires no checking at interstate check posts to facilitate smooth flow of high value perishable and time sensitive items.
V.	Overworking of drivers leading to Accidents and India tops in the accident deaths.	Better equipped roads and transportation system helps in speedy deliveries with lesser rates of accidents.

Out of the total 3.34 million km road length, National Highways is just 2 % of total road network, but carries 40 % of total traffic. Further, amongst the sixty thousand odd km National Highways and 130,000 km State Highways, only 2 % of their length is four-lane, 34% two-lane, and 64% single lane. As far as National Highways are concerned, only 5% of their length is four lanes, 80% two-lane and the balance 15% continues to be single lane. The deficiencies in the road network are causing huge economic losses. The rapid growth of traffic from 1.9 to 8.8 million in a span of two decades @ 8.9% per annum without matching growth of capacity has only added to the deterioration of the network. The 11th Five Year Plan has fallen short of its targeted spend, which has given way to an imperative need to increase speed of government investments in the infrastructure sector. One solace is the news that the construction of highways, which had dipped to dismal levels in the past few years, has picked up pace and official data shows that 11 km of roads are being added every day. If the trend is sustained, the government could well be on track of achieving 20 km per day, which Kamal Nath had over ambitiously projected, immediately after taking charge of the ministry.

1.2 Back Ground of Study

Based on road user cost, it is estimated that up gradation of congested two-lane highways would lead to savings of over 20 % in the road user costs. Further the better-quality road surfaces would bring in increased efficiencies to industrial establishments through faster transportation of its raw materials as well as finished goods and in turn reducing the cost of burden inventories. The Indian automobile industry today manufactures a large variety of multi-axle vehicles with turbo charged engines, but most of these are currently exported. The Indian industry needs large freighters to transport goods. The automobile industry has necessary facilities to manufacture them in sufficient quantities. The inadequate road infrastructure hence acts as an economic bottleneck impeding growth of both these industries [MOSRT&H 1998]. Availability of an efficient and widespread road network is an essential pre-requisite for a sustainable economic growth of a country. It is a significant fact that India has the second largest road network in the world spread over 5.3 million kilometers, which transports about 60 % of all goods in the country and 85 % of overall passenger traffic. National highways constitute about 1.9 % of road network, but carries about 40 % of the total road traffic. The Ministry of Road, Transport & Highways is primarily responsible for development and maintenance of National Highways. The main construction programs implemented by the Ministry include NHDP (National Highway Development Programme), NH (O) (National Highways (Original)), Special Accelerated Road Development Programme, Special programme for Development of Road Connectivity and State Roads in Left Wing Extremism (LWE) Affected Areas etc. The Ministry had a target of 10,000 kilometers during the financial year 2015-16. Out of this, they could achieve a target of 6029 kilometers up to March, 2016. Since the pendency of highways development projects was increasing and some of important projects were left halfway by the contractors mainly on account of non availability of regional funds and Banks and other infrastructure lending institution were feeling reluctant to come forward for financing the highways sector, the Committee decided to take up the issues related to "lending in road sector for consideration; to analyze the factors which are hamper the construction of roads and highways". National Highway Development Project (NHDP) as shown in Table 1.2 was commenced.

Table 1.2 Phase wise details of highway projects under NHDP

Phase	Project	Total Length in km	Approved Cost in Rs Crore	Length Completed in km
I	GQ,NS-EW corridors, port connectivity & others	7522	30300	7521
II	4/6-laning north south- east west corridor, other	6647	34339	5893
III	Up gradation, 4/6-laning	12109	80626	6608
IV	2 - laning with paved shoulders	14799	27800	1510
V	6-laning of GQ and high density corridor	6500	41210	2238
VI	Expressways	1000	16680	NIL
VI	Ring roads, bypasses and flyovers and other structures	700 km ring roads/ bypass + flyovers	16680	22

NHDP initially envisaged four laning of the existing high density highway corridors linking four mega metropolitan cities of Delhi, Mumbai, Chennai and Kolkata, popularly known as Golden Quadrilateral (GQ), and providing North South East West (NSEW) corridor linking Srinagar in the North and Kanyakumari in the down South, and Porbandar (Gujarat) in the West to Silchar (Assam) in the East along with other projects including those providing connectivity to major ports in the country with overall length of 14,146 km at an estimated cost of ` 580 billion (at 1999 price level). NHDP is one of the largest highway projects in the world as shown in Fig 1.1.

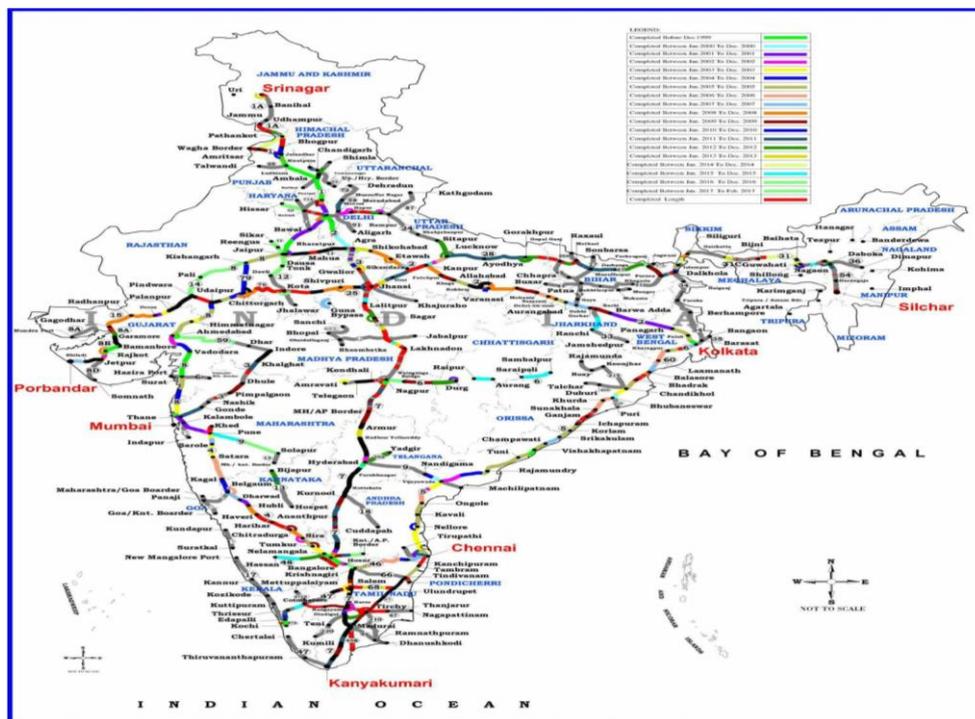


Fig no. 1.1 Completed national highways 2017 NHDP showing GQ and NSEW Corridor

(Source: [http:// www.nhai.org/gqmain_english.htm](http://www.nhai.org/gqmain_english.htm))

2. LITERATURE REVIEW

The main purpose of literature review is to give an insight into the existing literature on the subject of research with an attempt to gauge the breadth and depth of the research work carried so far. This is an essential pre-requisite for proceeding ahead in search of the persistent gaps in the topic of research and ultimately to bridge the vacuum with the new findings and so on.

Pre-Budget Economic Survey (2007) stated that the problems in land acquisition, removal of structures, shifting of utilities and law and order in some states are among the problems affecting the growth of the road sector. In order to facilitate investment in infrastructure, the government will have to ensure long-term funding with long pay back periods, for example from insurance and pension funds. Thus, the success on the infrastructure front will be facilitated by the development of a vibrant bond market and pension and insurance reforms. A single unified exchange-traded market for corporate bonds would help create a mature debt market for financing infrastructure.

As per MOS&PI (2008) status report, many of the projects have been delayed on account of suspension of contracts and the time taken for award of fresh contracts. This has resulted in rescheduling of large number of sections due to failure of contracts. While the cost overruns due to general inflation cannot be avoided, the escalation on account of delays can be minimized. The Standing Committees have been instituted in each Ministry to review the time and cost overruns in projects and to fix responsibility for making the monitoring mechanism to be effective. In general, the following reasons have been stated to be contributing to time and cost overruns:

Reasons for Time Overruns

- Lack of supporting infrastructure facilities
- Delay in finalization of detailed engineering plans, release of drawings and delay in availability of fronts
- Changes in scope/delay in finalization of the scope
- Industrial relations and law and order problems
- Delay and uncertainty in feedstock supply
- Pre-commissioning teething troubles
- Technology problems
- Geological surprises.

Reasons for Cost Overruns

- Time overruns
- Changes in rates of foreign exchange and statutory duties
- High cost of environmental safeguards and rehabilitation measures
- Higher cost of land acquisition
- Change in the scope of the project
- Higher prices being quoted by the bidders in certain areas
- Under-estimation of original cost
- General Price rise.

Comptroller and Auditor General (2005) on the slow progress of NHDP (Phase I) has criticized the NHAI for completing only 1846 km stretches, out of the target 6359 km of national highways by June 2004. In its report,

it is said that the overall performance of NHAI in terms of output in NHDP Phase I (Golden Quadrilateral) was only 29 percent. The report has pointed out that there was no corporate plan to implement such a large project. Deficient Planning and inefficient Contract Management by the Design and Project Consultants contributed to the underperformance.

Parliamentary Committee on Public Undertakings (2006) has observed that there are several areas where the National Highways Authority of India (NHAI) and the Ministries concerned need to get their act together. Based on its study on the implementation of the NHDP Phase-I, the Committee stated that the lack of steps taken by State governments to acquire land for construction of roads is the main factor for delays. Additionally, the Committee has stated that a time limit for processing of bids for awarding contracts should be drawn up and strictly adhered to. It has also called for reports on performance of contractors on a day-to-day basis and imposition of stiffer penalties in case they under-perform and cause delays. For expeditious land acquisition, the National Highways Act, 1956 may be amended so that a time limit is prescribed for initiation of arbitration proceedings, acquisition through mutual consent, and possibility of invoking an urgency clause for faster acquisition in special cases. The Committee also recommended the strengthening of project supervision methods adopted by the NHAI.

Parliamentary Committee on Transport, Tourism and Culture (2005) recommended that the NHAI should play a proactive role in ensuring strict compliance of the targets fixed for completion of awarded projects and also the schedules for award of contracts in the pending projects. The Committee was of the view that proper verification of bank guarantees submitted by contractors should be undertaken at the initial stage itself to avoid termination of the contracts at a later stage. The Committee noted that increasing numbers of contracts are under implementation and being awarded. Therefore, it was recommended that NHAI should be vigilant in respect of each contract and should strictly enforce the compensation conditions in the contracts in respect of non-performing contractors. The Committee, further, recommended that NHAI should not wait for the targeted date of completion to initiate action but should fix short-term targets (intermittent mile stones) for the contractors so that the projects can be monitored constantly and immediate and early remedial action may be taken in case of anticipated delays. The Committee also felt that NHAI should draw-up a database of the performance of the contractors involved in NHDP and encourage outstanding contractors, who strictly comply with the construction standards and quality control and also complete the projects well within the targeted date, to undertake more and more projects as incentives.

Pre-Budget Economic Survey (2007) stated that the problems in land acquisition, removal of structures, shifting of utilities and law and order in some states are among the problems affecting the growth of the road sector. In order to facilitate investment in infrastructure, the government will have to ensure long-term funding with long pay back periods, for example from insurance and pension funds. Thus, the success on the infrastructure front will be facilitated by the development of a vibrant bond market and pension and insurance reforms. A single unified exchange-traded market for corporate bonds would help create a mature debt market for financing infrastructure.

The **268th Flash Report on Central Sector Projects (2008)** has brought out that in the Road Transport and Highways Sector, 93 packages have slipped in the range of 1-12 months vis-a-vis the scenario the previous month because of the various reasons in general such as tardy progress by the contractor, termination of contract, law and order situation in the region and late award of contract etc. Report of the Inter- Ministerial

Committee (2009) strongly recommended major steps for restructuring and strengthening of National Highways Authority of India (NHAI), which is the implementing agency for the National Highway projects. Institutional mechanisms are required to be established to address bottlenecks arising from delays in environmental clearance, land acquisition etc. A special focus is being provided for traffic management and safety related issues through the proposed Directorate of Safety and Traffic Management. It is expected that the sum total of these initiatives should be able to deliver an efficient and safe highway network across the country. In order to specify the policy and regulatory framework on a fair and transparent basis, a Model Concession Agreement (MCA) for PPPs in national highways has been mandated. It is expected that this common framework, based on international best practices, will significantly increase the pace of project award as well as ensure an optimal balance of risk and reward among all project participants.

Al-Momani (2000) has tried to establish a relation between actual times vs. planned time of a construction projects. He had developed a simple linear regression equation categorizing the projects as housing, office and administrative building, school projects, medical centers and communication facilities. Though the various statistical coefficients were satisfying 99% confidence level, the author has himself admitted that the model failed to include intrinsic variables such as construction experience of the contractors. More over this model serves as a post mortem analysis since actual construction time is required to perform the analysis, thus useful only for completed projects.

Ram Singh's (2010) study is aimed at covering all the infrastructure sectors in India. He had made an attempt to evolve a general purpose simultaneous equation for time overruns incorporating technical and natural factors, contractual failures and economic factors. Though the model is exhaustive covering the entire infrastructure sector, it has failed to explain the reasons for superior performance of certain states.

2.1 Necessity of the Study

The main factors contributing to occurrence of time overrun in the NHDP packages according to Project Implementation Units (PIUs) of NHAI were stated to be adverse law and order situation in states like Bihar and Jharkhand; difficulties experienced in land acquisition as in Maharashtra, Karnataka, and Tamil Nadu; removal of large number of structures including places of worship like temples, mosques, and, 'majars'(tombs), 'dargahs' as in case of Tamil Nadu, Andhra Pradesh from the alignment of various packages; forest clearances and felling of trees in states like Jammu and Kashmir, Madhya Pradesh etc; removal of various utilities such as water mains, electrical lines, sewer lines, telephone lines, wind mills as in Bihar, Karnataka, Maharashtra, West Bengal and Tamil Nadu; pending court cases as in West Bengal and Gujarat; slow progress on the part of contractors, non-availability of quarry

stone of the desired grade, award of contracts without land acquisition; changes in the design, delay in obtaining approval for rail over/under bridges (ROB/RUBs), changes in alignment subsequent to award of contract due to factors such as local soil and geology of the region; inadequate deployment of qualified staff by contractors at project-sites; difficult geology of the region as in case of packages undertaken in the Deccan region of Maharashtra. The reasons attributed by PIUs appear to be superficial without taking cognizance of the root causes. For instance, delays due to failure of contractors largely owes to certain administrative lapses such as slackness in the functioning of highway authority officials due to fear of vigilance/audit, policy failure on the part of the government on capacity building particularly in terms of manpower and spiraling effect of

encumbrance free land not made available to contractors for commencing the works etc. Thus the ground scenario is not that simple given the complexity of the working environment in this subcontinent.

3. TIME AND COST OVERRUNS IN INDIA

3.1 Definitions: Every infrastructure project has to undergo several stages: from planning of the project, to its approval, to awarding of contract(s), to actual construction/procurement, and so on. Broadly put, a project’s lifecycle has three phases; development, construction, and operation-and-maintenance phase. In the beginning of the development phase, the project sponsoring department prepares estimates of time and cost (funds) needed to complete the project. An expected date of completion is also announced. The actual date of completion is invariably different from the expected date. Therefore, for each project we can define percentage time overrun as the ratio of the time overrun and the implementation phase for the project (multiplied by one hundred). Clearly, the time overrun and therefore the percentage time overrun can be positive, zero or even negative. Similarly, we define ‘cost overrun’ as the variation between the actual cost and the initially projected (i.e., expected) cost of the projects. The initially predictable cost is called the *initial* project cost. This is the estimated cost of project works. It is estimated when a project is planned and generally is arrived at using current input prices. The actual cost becomes known only at the time of completion at the end of phase two. Percentage cost overrun for a project is defined as the ratio of the cost overrun and the initially projected cost of the project (multiplied by one hundred). Again, percentage cost overrun can be positive, zero or negative.

Table No: - 3.1 THE DATA AND SUMMARY STATISTICS

ASPECT	DESCRIPTION	DATA SOURCE
Initial date of commissioning	It is the initially planned (i.e., expected) date of completion of the project	MOSPI reports
Actual date of commissioning	It is the actual dates of completion of the project	MOSPI reports
Implementation phase	The duration in which a project is planned to be completed, i.e., the duration between the date of approval of the project and its <i>expected</i> date of completion.	Calculation based on the data collected from MOSPI reports.
Time over Run	The time difference (in months) between the actual and the initially planned dates of completion	Calculation based on the data collected from MOSPI reports
Initial project cost	The initially projected (i.e., expected) cost of the project.	MOSPI reports
Actual project cost	The actual cost at the time of completion of the project	MOSPI reports
Cost overrun	The difference between the actual cost and the initially projected (i.e., expected) cost of the project.	Calculation based on the data collected from MOSPI reports.

3.2. Method of time and cost overruns

The status report of Ministry of Statistics and Project Implementation (MOS&PI) highlights the prevailing scenario on the inordinate delays caused in the implementation of highway projects. Various vital statistical parameters of these highway projects were deliberated in detail including the trend of time overruns. Extent of delays and corresponding reasons were also brought out covering the various geographical regions of the country. Certain interesting inferences were also drawn with respect to the highway projects carried out under various phases of NHDP. Regression analysis is carrying out on the ongoing highway projects using computer program and mathematical equations be resultant between various projects parameters to describe the behavior of time and cost overruns. Delay Index model incorporating the various causes of delay be evolve for judgment of time overruns and for predicting the future outcomes.

4. RESEARCH METHODOLOGY

Before embark on any study, a comprehensive literature survey from the existing technical journals and various government publications and reports be carried out on delays in the NH project implementation. In order to untie these complex issues, a Questionnaire be circulated amongst the various stake holders such as administrators in authoritarian authorities such as NHAI, MORT&H etc, construction firms engaged in construction works, consultants, engineers and so on. The queries in the questionnaire were quite diversify ranging from hindrance bring out by PIUs such as land acquisition, utility shifting and other ground problems to macro-economic and political issues relating to mode of funding, capacity hiccups and even governance. The respondents be ask to rate a number of variables using a 6 point rating scale. Along with the objective evaluation of various factors already listed in the questionnaire, a deliberate attempt be made in keeping the questionnaire quite open in looking for suggestions from the respondents. Apart from the questionnaire survey, statistical analysis such as correlation and regression be carry out on the existing secondary data draw from MOS&PI's status reports using computer software package. The mathematical equations between the Overruns and project variables were developed through the regression analysis.

5. RESULT AND CONCLUSION

Most of the road projects are kept aside and are delayed due to objections from owners of the land. In the present scenario many projects are authorized by the Government, but after that it is not even started due to land issues at the initial phase of the project itself. The impact of land issues are getting serious now a days. It not only causes delay but also causes overrun of cost in the project. Therefore it is essential to formulate a strategy to overcome the issue in the initial stage itself.

Second ranked cost overrun factor in road projects is the cost escalation. It means increase in price of money. It is caused due to price changes in the men (wages of labour), material, machinery and other construction related activity cost. This price change is mainly due to inflation and it is one of the predominant factors for the cost overrun in road projects. This uncontrollable cost is mainly applicable for labour wages and material price escalation. It seems there is no solution for this problem, but effective planning at the procurement stage will reduce the price escalation, a little amount.

From the study it was observed that many respondents mainly focused on completing the project within the budget to control the cost overrun. The most major factors from the study are based on respondents perspective

which includes the issues in land acquisition, cost escalation of workers' wages and material, financing and payments for completed works (delays in payments), Force majeure (act of god), design changes during construction phase, delays in shifting existing utilities, increase in quantities of materials due to actual site conditions, non-availability of construction materials, design errors, unstable or increase in interest rates.

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