TIME & COST OVERRUN ANALYSIS OF HIGHWAY PROJECTS

A thesis submitted in partial fulfillment of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY

By

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JANUARY 2014
DECLARATION

I hereby declare that the thesis entitled “TIME & COST OVERRUN ANALYSIS OF HIGHWAY PROJECTS” submitted for the award of Degree of Doctor of Philosophy is my original work and the thesis has not formed the basis for the award of any degree, diploma, associateship or fellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any degree or diploma.

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MAKAM KISHORE KUMAR
CERTIFICATE

This is to certify that the thesis entitled “TIME & COST OVERRUN ANALYSIS OF HIGHWAY PROJECTS” that is submitted by Makam Kishore Kumar in partial fulfillment for the award of Degree of Doctor of Philosophy in CIVIL ENGINEERING to the K L University is a record of bonafide work carried out by him under my guidance and supervision.

The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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Dedicated to
my mother & father for selfless upbringing
my wife Prasanthi for her relentless & unstinted support
my beautiful daughters Amulya and Shreya for their love & affection
ACKNOWLEDGEMENTS

I am highly indebted to my research guide Dr Ch Hanumantha Rao, Prof & Head of Dept of Civil Engineering at KL University for the continuous support for carrying out the research work. His meticulous & methodical way of functioning in a most disciplined manner throughout the research period with his constructive suggestions is grossly responsible for producing this thesis. Discussions with him proved to be quite probing and had always led to meaningful & thought provoking sessions. He had always acted as a friend, philosopher & guide playing an instrumental role in the successful completion of my research work.

Thanks are also due to all the respondents of the questionnaire circulated by me for patiently going through the voluminous queries and in penning their valuable opinions & suggestions without which my research work would not have been completed. My sincere gratitude is also due to all my colleagues especially Shri Jainendra Kumar, Technical Examiner at Border Roads Inspection Cell of Govt of India for suitable refinement to my questionnaire and constant encouragement. Further I thankfully acknowledge the assistance provided by Professors Tridib, Arup Roy, Mrinmoy and students of Business Administration Mr Abhijeet & Chetri of Tezpur University for software assistance through SPSS computer package in carrying out the statistical analysis.

Makam Kishore Kumar
ABSTRACT

The introductory chapter gives an insight into the present scenario on Indian highways including cross continental comparison with the neighbouring China as well as developed nations such as USA and Europe. The poor quality of road infrastructure coupled with heavy congestion on important national highways has led to initiation of National Highway Development Project (NHDP) was discussed in detail in the subsection background of study. The wide prevalence of delays in the implementation of highway projects under NHDP has necessitated the present study on time and cost overruns. This chapter further discusses on the research methodology adopted, limitations of the study and future scope for further research.

Chapter 2 covers the literature survey in detail covering the period since 1980. Important findings of various researchers on project delays were depicted for the information of the reader. The survey included authors from all over the globe and reasons for delays in construction projects comprised from planning as well as design and construction phases. Shortages of resources, inclement weather, frequent changes to design and scope of work, lack of coordination between client and contractors, unforeseen site conditions etc were mostly listed as reasons for project delays. On the contrary, cost overruns were stated to be on account of inflationary price rise, higher cost of land acquisition and under estimation of the original cost. Few constructive suggestions from parliamentary and inter ministerial committees also found a mention in the literature survey.

The analysis on time and cost overruns is extensively covered in the chapter 3. 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 was carried out on the ongoing highway projects using
SPSS computer program and mathematical equations were derived between various project parameters to portray the behavior of time and cost overruns. Delay Index model incorporating the various causes of delay was evolved for estimation of time overruns and for predicting the future outcomes.

Chapter 4 further takes the analytical part of the research one step further in ascertaining the various causes of delays and subsequent diagnosis of the time and cost overruns. The prominent reasons for delay such as land acquisition was discussed in detail going into the historical and legislative perspectives. Questionnaire survey findings on the land acquisition front were also debated with focus on micro level organizational problems and the recent government initiatives in the form of land legislation bill introduced in the parliament. A sizeable portion of thesis was devoted to lacunae in the preparation of Detailed Project Reports (DPRs) and their impact on the highway projects along with the corrective measures. The next most important problem was contractual matters and dispute resolution mechanism suggesting procedural reforms for effective contract administration. Further financing mechanisms of NHDP were discussed at length ever since the inception of NHDP. Certain innovative suggestions such as beneficiary participation and auctioning of highway projects were aired for the sound implementation of NHDP. Strategies for future implementation such as project packaging, appropriate mix of BOT, ways and means to address the capacity constraints were highlights of this chapter.

Hurdles faced in the implementation of NHDP were also highlighted in chapter 4 along with solutions in the form of computer assisted project management techniques, fast track construction concepts and induction of innovative construction techniques. Problems faced in the implementation of massive highway programs in United States and China were incorporated in this chapter drawing parallels with NHDP thus not only throws light on their experiences but also helps in learning few lessons. Increased involvement of private sector in the form of public private participation was felt as the need of the hour and the same was discussed.

Concluding chapter 5 at the end tried to summarise the findings of the analysis of time and cost overruns. This chapter has brought out the importance of physical connectivity through highway infrastructure in the country through the massive
development programme in the form of NHDP and at the same time envisaging the role of the governments in removing the constraints. The various impediments on the path of project implementation were listed according to their criticality. Tabulation of various factors causing delays and suggested measures to overcome the delays is the highlight of this chapter giving the readers the crux of the research carried out by the research scholar. The state of preparedness in India is covered under overall general economic scenario. The chapter ends with a note of optimism shared by the engineering fraternity stating that the committed target of achieving the road construction at the rate of 20 km per day is attainable if timely corrective actions are taken.
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GLOSSARY

Accounting Year (AY) or Financial Year (FY) means the accounting year commencing on 1st April of any calendar year and ending on 31st March of the subsequent year.

Arbitration Act means Arbitration & Conciliation Act 1996 and shall include any amendment to or any re-enactment thereof as in force from time to time.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

Build Operate Transfer (BOT) means the concessionaire meets the upfront cost of construction and expenditure on annual maintenance and recovers the entire cost along with the interest from collection the user fee (toll) collections during the concession period. The highway authority viz., NHAI gives the project requirements based on DPR and capital grant up to a maximum of 40% under the risk sharing concept as envisaged in the Model Concession Agreement (MCA). In the case of annuity model, the concessionaire meets the entire upfront cost (no grant is paid by the client) and the expenditure on annual maintenance recovering the entire investment through pre-determined annuity payments by NHAI.

Cess is nothing other than a tax or levy. It is to be levied as per the prescribed percentage on items specified by law. Cess is often used as rider to a tax for collecting additional revenue for a specific purpose. The then Hon’ble Finance Minister of India during his budget speech for the year 2003-04, has announced additional levy of cess of 50 paise (US 1 cent) per litre each on petrol and high-speed diesel. The revenue generated from the cess would be used to finance all categories of roads.

Commercial Operations Date (COD) starts from the date on which Independent Engineer (IE) issues the provisional or completion certificate in accordance with the provisions of MCA.

Completion Date is the date of completion of the works as certified by the Project Management Consultant (PMC) or his nominee in accordance with the relevant contract conditions.

Concessionaire is a person or firm that operates a business within the premises belonging to another (the grantor) under a concession, usually as the only seller of certain goods or services.
Contract is the agreement entered between the employer and the contractor to execute, complete and maintain the works.

Contract Price is the price stated in the letter of acceptance and thereafter as adjusted in accordance with the provisions of the contract.

Contractor is a person or corporate body whose bid to carry out the works has been accepted by the employer.

Contractor’s Bid is the completed bidding documents submitted by the contractor to the employer.

Days are calendar days, months are calendar months.

Defect is any part of the Works not completed in accordance with the Contract.

Defects Liability Period is the period named in the contract data and calculated from the completion date.

Detailed Project Report (DPR) is a comprehensive report provided by NHAI to the bidders as part of the bidding documents comprising the following:

Vol I - Main Report Part A and B
Vol II - Design Report (Bridges and Cross Drainage) and Sub Soil Investigation (SSI)
Vol III - Design Report (Material) including Appendices
Vol IV - Environmental Assessment Report
Vol V - Technical Specification

Contract - Part A – Road Works
and Drawings - Part B – Bridges & Cross Drainage

Employer is the party who will employ the Contractor to carry out the Works.

Equipment is the contractor’s machinery and vehicles brought temporarily to the site to construct the Works.

Joint Venture means two or more companies or contractors may jointly undertake contract or works. Each entity would be jointly responsible for completing the task as per the contract.

Material are all supplies, including consumables, used by the contractor for incorporation in the works.

Order of Precedence (if not specified in the contract agreement) means the documents forming the contract shall be interpreted in the following order of priority:

(1) Agreement
(2) Letter of Acceptance and notice to proceed with works
(3) Contractor’s Bid
(4) Contract Data

(5) Conditions of Contract including Special Conditions of Contract

(6) Specifications

(7) Drawings

(8) Bill of quantities and

(9) Any other documents listed in the Contract Data as forming part of the contract.

**Plant** is any integral part of the works which is to have mechanical, electrical, electronic or chemical or biological function.

**Site Investigation Reports** are those which were included in the bidding documents and are factual interpretative reports about the surface and sub-surface conditions at the site.

**Site** is the area defined as such in the contract data.

**Specification** means the specification of the works included in the contract and any modification or addition made or approved by the employer or his nominee.

**Subcontractor** is a person or corporate body who has a contract with the contractor to carry out a part of the work in the contract which includes work on the site.

**Temporary Works** are works designed, constructed, installed and removed by the contractor which are needed for construction or installation of the works.

**Variation** is an instruction given by the PMC or his nominee which varies the works.

**Works** are what the contract requires the contractor to construct, install and turn over to the employer as defined in the contract document.
ABBREVIATIONS

₹ - Indian Rupees
ACB - Anti Corruption Bureau
ADB - Asian Development Bank
AHQ - Army Head Quarters
AP - Affected Populace
AT - Arbitral Tribunal
BOT - Build, Operate & Transfer
BRO - Border Roads Organisation
BRTF - Border Roads Task Force
CCEA - Cabinet Committee on Economic Affairs
CoI - Committee on Infrastructure
CPM – Critical Path Method
CRF - Central Road Fund
CVC - Central Vigilance Commission
DGBR - Director General Border Roads
DORT&H - Department of Road Transport & Highways
DPR - Detailed Project Report
DRB - Dispute Resolution Board
Dy CAG - Deputy Comptroller & Auditor General
EGoM - Empowered Group of Ministers
EPC - Engineering, Procurement & Construction
ET - Economic Times
EV - Expected Value
FDI - Foreign Direct Investment
FIPB - Foreign Investment Promotion Board
GAIL - Gas Authority of India Ltd
GoI - Government of India
GQ - Golden Quadrilateral
GREF - General Reserve Engineer Force
HPCL - Hindustan Petroleum Corporation Ltd
IEG - Independent Expert Group
IFA - Internal Financial Advisor
IMG - Inter Ministerial Group
INC - Indian National Congress
IOC - Indian Oil Corporation,
IRCC - Indian Road Construction Company
IRCON - Indian Rail Construction Company
IRR - Internal Rate of Return
JBIC - Japan Bank for International Cooperation
JCO - Junior Commissioned Officer
JV - Joint Venture
LA - Land Acquisition
MCA - Model Concession Agreement
MDR - Major District Road
MES – Military Engineer Services
MOEF – Ministry of Environment & Forests
MORT&H - Ministry of Road Transport & Highways
MOS&PI - Ministry of Statistics & Project Implementation
MOU - Memorandum of Understanding
MPRDC - Madhya Pradesh Road Development Corporation
MSRDC - Maharashtra State Road Development Corporation
NAC – National Academy of Construction
NBCC - National Building Construction Company
NDA - National Democratic Alliance
NGO - Non Governmental Organizations
NH - National Highway
NHAi - National Highways Authority of India
NHDP - National Highway Development Programme
NICMAR – National Institute of Construction Management & Research
NPCC - National Projects Construction Corporation
NREGA - National Rural Employment Guarantee Act
NSEW - North South East West Corridor
NTHDP - National Trunk Highway Development Project
OC - Officer Commanding of the rank of Executive Engineer
O&M – Operation & Maintenance
ONGC - Oil & Natural Gas Commission
PCB - Pollution Control Board
PIUs - Project Implementation Units
PM - Prime Minister
PMGSY - Prime Minister Gram Sadak Yojana
PMO - Prime Minister’s Office
POSDCORB - Planning, Organising, Staffing, Coordinating, Reporting & Budgeting
PPP - Public Private Partnership
PPPAC - Public Private Partnership Approval Committee
PSUs - Public Sector Undertakings
PWD - Public Works Department
Q/E - Quarter Ending
R&R - Resettlement & Rehabilitation
RCC - Road Construction Company (analogous to Division in PWDs)
RFP – Request for Proposal
RFQ – Request for Qualification
RITES - Rail India Technical & Economic Consultancy Services
ROB - Rail Over Bridge
RUB - Rail Under Bridge
SAIL - Steel Authority of India Ltd
SARDP - Special Accelerated Road Development Programme
SEZ - Special Economic Zone
SH - State Highway
SOE - State Owned Enterprise
SPV - Special Purpose Vehicles
SWOT – Strengths, Weaknesses, Opportunities & Threats.
TS - Technical Sanction
UPA - United Progressive Alliance
UPBCC - Uttar Pradesh Bridge Construction Corporation
USA - United States of America
USD – United States Dollars
UV - Utility Value
VGF - Viability Gap Funding
YEA - Yamuna Expressway Authority
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