

Cost Overrun And Time Overrun In Highway Projects: A Review

Jai prakash singh¹, Mohd. Afaque khan², Neeti Mishra³

¹Dept of Civil

²Assistant Professor, Dept of Civil

³Head of Department, Dept of Civil

^{1,2,3} Babu Banarsi Das University, Lucknow (U.P.), India

Abstract- The Construction industry is one of the important economic industry in India and is the main motivating force in Indian national economy. But, it travels from a number of problems that affect time, cost and quality performances. Good management of construction projects is based on three major factors i.e. time, cost and quality. Time delay and Cost overruns has been a big matter in many Indian construction projects[1]. The successful completion of construction projects within the given time has become the most valuable and challenging task. The successful execution of construction projects and keeping them within estimated cost and prescribed schedules depend on a methodology that requires sound engineering judgment. Delays are incidents that impact a project's progress and postpone project activities. The actual date of completion is invariably different from the expected date[2]. Construction delay is a major problem facing by the construction industry. In most construction projects, there are delays and their impact level varies from project to project ranging from a few days to years.

Over that period, numerous changes to the project scope and schedule will occur. Many factors that influence project costs are undefined during the early stages of project development, such as knowledge about right-of way cost and alignment, environmental mitigation requirements, traffic control requirements, or work-hour restrictions[3]. Moreover, there are process-related factors that can drive project cost increases, such as unforeseen engineering complexities and constructability issues, changes in economic and market conditions, changes in regulatory requirements, local governmental and stakeholder pressures, and a transformation of community expectations. Managing large capital construction projects requires the coordination of a multitude of human, organizational, and technical resources. Quite often, the engineering and construction complexities of such projects are overshadowed by economic, societal, and political challenges. Within the transportation community, project cost escalation has attracted management, political, and stakeholder attention at federal, state, regional, and local levels. News reports of project cost escalation cause the public to lose confidence in the ability of transportation agencies to effectively perform their responsibilities. Additionally SHA

management must deal with the disruption project cost increases cause in priority programs and the fact that other projects have to be delayed or removed in order to accommodate higher project costs.

Keywords- cost overruns, time overrun, highway construction, Causes of Delay

I. INTRODUCTION

A commonality among state departments of transportation is the inability to complete transportation projects on time and within budget. Time delay, cost overruns are generally due to factors such as design errors, unexpected site conditions, increases in project scope, weather conditions, and other project changes. A cost overrun may be generally expressed as a percent difference between the final cost of the project and the contract award amount[45]. When this value is negative, it is called a cost under run. A time delay is simply the difference between a project's original contract period at the time of bidding and its overall actual contract period at the end of construction. Indian infrastructure investment in general and highway construction in Besides being unique, expensive and usually carried out within a limited time frame, construction projects have been described as complicated and uncertain in nature, as no two construction projects are ever exactly the same.

Even if two construction projects are similar, the opportunity for exactly repeating the process of execution is very low, as most of the projects' elements are site-specific[5]. Although the level of investment represented by construction projects has increased over the years, construction projects have a consistently poor record in finishing within budget[6]. consider cost overrun as a "regular feature" for public projects. defines cost overrun as "...the degree to which the final cost of the project exceeds the 'base' estimate".

Construction projects experiencing cost overrun have the potential to become defaulted projects, with a resultant

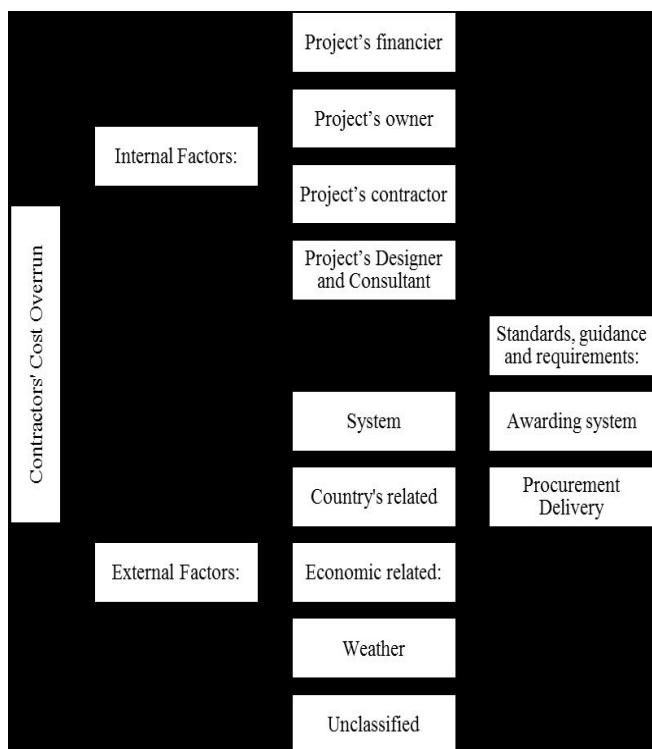
significant impact on all the projects’ parties. For example: clients will be unable to use the facility, as the projects have not finished yet, and consultation and designing fees might increase. For contractors the impact could include loss of reputation and being “trapped” in only one project for long time.

In light of the above, cost overrun should be regarded as a vital issue in the management of construction projects globally; this phenomenon is not limited to a specific country as the above studies show. The variation on the percentages of cost overrun could be related to different factors such as the project size [14]-[16], project type [11] and project location as it was one of the main findings obtained from the following studies [13], [17]-[19]. Equally, the studies support the claim that the worldwide findings are not always applicable for individual countries.

Categories of time overrun are:-

1. Causes related to Contractor
2. Causes related to Owner
3. Cases related to Consultant
4. Cases related to Services and Utilities
5. Causes related to Government Regulations

Cost overrun causes.



Internal Factors:

A. Project’s Financier

Factor	Frequency
Owners’ financial difficulties.	2
Too small a design budget.	1
Slow and delay payment of completed work.	5

B. Project’s Owner

Factors	frequency
Owner’s lack of experience.	2
Inadequate project preparation and planning (preconstruction study).	4
Unrealistic design development periods.	7
Premature tender documents (drawings, bill of quantities, specifications, contracts and legal documents).	1
Late start of the planning process, and with too low a budget.	2
Lack of detail and definition, incomplete, or incorrect Design brief.	1
Poor project management practices.	1
Owner project management costs.	1
Long period between design and time of tendering	1
Unrealistic/ Inaccurate duration of contract period	2
Deficiencies in cost estimates prepared by public Agencies	4
Too many changes in owners’ requirements or definitions.	1
Changes in owner’s brief.	1
Frequent design changes.	1
Change in the scope of the project.	8
Change orders by client.	7
Changes in material specifications and type.	2
Additional works.	1
Shortening of contracts period.	4
Delays in decisions making and work approval.	1
Delays (decision making, in approval of drawings,	1

material delivery).	
Client's over influence/interference on the construction process.	1
Lack of coordination between project's parties.	2
Lack of communication between project's parties.	5
Wrong / inappropriate choice of site.	4
Insufficient information/investigation about ground conditions.	9
Services relocation.	1
Contractual claims.	3

C. Project's Contractor

Factor	Frequency
Technical incompetence, poor organizational structure, and failures of the enterprise.	1
Lack of contractor's experience	8
Poor project management.	1
Incompetent subcontractors and suppliers	2
Incorrect preparation and planning by contractor	4
General poor preparation, planning and investigation of existing site conditions by contractors.	1
Inadequate review for drawings and contract documents.	1
Poor cost advice, inadequate contingency allowance or assessment of risks.	1
Optimism bias.	1
Wrong method of cost estimate.	3
Inaccurate cost estimates.	4
Lack of cost planning, monitoring and controlling during pre-and post-contract stages.	9
Some tendering manoeuvres by contractors, such as front- loading of rates.	1
Contractor's poor site management and supervision skills.	13

Cash flow and financial difficulties faced by contractor during construction stage.	3
High interest rates charged by banks on loans received by contractors	5
Contractor's work overload	4
Mistakes during construction due to inadequate construction method.	5
Cost of the Reworks.	2
Lack of coordination between general contractor and subcontractors	1
Delay payment to supplier /subcontractor.	1
Delays in costing variations and additional works.	1
Delay in construction, supply of raw materials and equipment by contractors.	1
Delays.	3
Litigation costs	2
Lack of contractors' manpower experience, knowledge and training.	2
Low labour productivity.	1
Low labour performance.	1
Shortage of available skilled and non-skilled labour.	11
Shortage in high-quality management personnel.	1
Lack of attracting skilful technicians for work.	1
Poor relationship between management and labour.	4
Increase in manpower cost due to environment restriction, insurance premiums and other social expenses of the workforce	8
Cost of afterhours work of the workforce.	1
Increment of materials prices.	9
Difficulties in obtaining construction materials at official current prices.	1
Inadequate material procurement.	1
Shortages of materials due to unreliable sources of materials on the local market.	7

Imported materials and plant items.	2
Late delivery/supply of materials and equipment by Contractors	5
Materials supplier’s manipulation.	2
Market conditions (materials and labour).	1
Increment of equipment’s/ equipment’s maintenance prices	5
Inadequate or inefficient equipment, tools and plants.	5

D. Project’s Designer and Consultants

Factor	Frequency
Designer lack of experience.	5
lack of experience of technical consultants.	6
Lack of design team understanding of cost and value.	1
Deficient tender documentation (design, bills of quantities and specification).	13
Inaccurate cost and time estimates.	8
Difference between selected bid and the consultants’ estimate.	1
Improvements to standard drawings during construction stage.	1
Inadequate monitoring and control procedures.	2
Delay Preparation and approval of drawings.	2
Delay in issuing information to the contractor, project’s inspection and handing over.	5

E. External Factors

External factors are divided into the following sub-factors which are:

1) System

a) Standards, guidance and requirements)

Factor	Frequency
Unclear division of responsibilities	1

and lack of clear requirements for professional management	
Lack of standard requirements from designers and poorly enforced professional liability of designers.	1
Disputes among the parties involved in the project (clients, contractors, consultants)	1
Absence of construction cost, specifications, and productivity standard data	4
Insufficient, unstandardized owner’s brief.	1
Culture of conflicts and lack of trust.	1
Inappropriate Government Policies.	4
Inadequate mode of financing projects.	5

b) Awarding System

Factor	Frequency
Practice of assigning contract to lowest bidder even if prices are unrealistically low.	4
Bureaucracy and late contract award.	3
Bidding fee competition with tight conditions.	1
Level and number of competitors	2
General lack of information especially at tender stage.	1

c) Procurement Delivery

Factor	Frequency
Unbalanced distribution of risk between projects’ party.	2
Mistakes, ambiguity and discrepancies in contract Document	3
Non adherence to contract conditions.	1
Inappropriate contractual procedure	2
Inappropriate contractor policies: such as: work suspensions owing, Long period of the project maintenance	4

E) Country Related

Factor	Frequency
Obstacles from government	1
Change in Government policies.	1
Delays in decisions making by Government, failure of specific coordinating.	1
Political complexities, insecurity and instability	1
Social and cultural impacts	2

1) Economic Related

Factor	Frequency
High Inflationary pressure.	6
Changes in pricing conditions	1
Unsettlement of the monetary exchange rate	4
Local economic stability	1
Effects of global economy.	1
Change of insurance cost.	2

2) Weather

Factor	Frequency
Effect of weather conditions	10

3) Unclassified

Factor	Frequency
High transportation cost due to Fuel shortages	3
Fraudulent practices, kickbacks, corruption	4

A. Frequent Design Change during Construction Phase

Although it is very unlikely that a project can be delivered without any variation during the construction stage[37], a long process for processing design change orders negatively impacts on the duration and cost of a construction project. Change in a project's design could be part of a construction project nature because of its inherent complexity and uncertainty. Design change causes delay as its needs to be reviewed and approved by clients. However, this factor was found to cause cost overrun in different developing countries. The factor scored highly among other factors of cost overrun in developing countries. For example, in Zambia it scored second highest. Lack of clearly defined project objectives and

scope was mainly the cause of frequent change orders in construction projects in these countries.

B. Contractors' Financing

It is usual that contractors face financing issue during the construction phase as they normally pay for works and receive payment after completing part of projects or the whole projects. Thus, contractors should make sure that they have sufficient funds available to enable them to undertake projects. Moreover, they should put all financing processes under control by adopting an effective project financing method. All the above points emphasise that a reliable contractor's financial status plays a primary role in delivering projects on time. Moreover, poor controlling of cost and cash flow during the construction phase would directly increase the cost of implementing a project, or it might lead to project delay that leads to financial penalties. In other words, if contractors meet financial difficulties, project progression will be affected. However, it is not unusual that contractors' face financial difficulties during the construction phase. For instance, a delay or inability to cover their direct and indirect costs.

C. Payment Delay

Slow or delayed payment to contractors for completed works is a very common complaint of contractors about project's client. It was identified in five different contexts and appears to occur more often in government funded projects because of a typically slow payment procedure (the public sector around the world is more bureaucratic because the level of power and decision-making is centralised). Failure to provide payment on time to contractors for the completed work will make it difficult for the contractors to meet (typically due to relatively small cash reserves) project objectives[38].

D. Lack of Contractors' Experience

Construction projects are tending to become more complicated and therefore place pressure on time (project duration) and expertise. A lack of contractor experience (and expertise) of the projects' type and location might lead to a rework component for the project or delay which increases the cost of implementing a project. It has been cited that lack of experience is one of the critical causes affecting the construction projects performance by different authors[39][40].

E. Poor Cost Estimation

Cost estimating could be defined as the process where an estimator arrives at an expenditure of resources necessary to complete a project in accordance with plans and specifications. The preparation of a detailed cost estimate for a particular construction project requires collecting, retrieving, and manipulating large amounts of independent, but related, cost and non-cost data and information in a time-effective manner. Cost estimation for projects is a characteristically complex exercise. Although estimation techniques have improved over the years, they are still regarded as imperfect. Because of the high uncertainty of construction projects, clients along with the contractor become better informed about the specific technological and material requirements of the project works after a project moves from the design phase to the implementation phase. Eg. poor ground conditions. There are several causes for an inaccurate cost estimate, and some of these causes may be similar to other causes of cost overrun. One of them is the psychology cause. Psychologists believe that most people tend to be more optimistic than realistic which is called optimism bias. In this situation, estimators and contractors make their decision based on delusional optimism (higher than actual rewards and lower than actual risks) rather than rational measuring of profits and losses. Other causes are[41][42]:

- 1) The data used to estimate the bid may be unreliable.
- 2) The absence of national database for prices to rely on.
- 3) Lack of estimators' experience.
- 4) Honest mistakes.

F. Poor Tendering Documents

Immature tendering documents were identified as causes of cost overrun in thirteen out of seventeen studies. Several factors have caused this issue including: the involvement of the designer as a consultant; communication gaps occurring between the contractor and designer; insufficient details in the working drawings and a lack of coordination between the parties.

G. Poor Material Management

Construction material is one of the most important elements in the execution of any construction projects. The importance of material management can be seen clearly from its definition[43]. materials management as “the system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, are obtained at a reasonable cost and most importantly are available at the point of use when required”.

II. CONCLUSION

One of the potential solutions to reduce the effect of the cost overrun in construction projects is the embedding of an effective resources (human, technical and material) management system within construction projects as it seems that most of the causes of cost overrun[46] are related to poor resources management. Moreover, effective communication between a project's internal and external stakeholders is a very important task to deliver projects successfully and reduce cost overrun. This task is more important in construction megaprojects where different government authorities are involved. To help contractors' financially and reduce the effect of payment delay for the completed projects, government should be involved to help contractors find a middle way with banks and other surety groups[38].

REFERENCES

- [1] Desai Megha and Bhatt Rajiv(2013), “Critical Causes of Delay in Residential Construction Projects: Case Study of Central Gujarat Region of India” *International Journal of Engineering Trends and Technology (IJETT)*, Volume 4 , no. 4, pp-762-768.
- [2] Dinesh Kumar R(2016), “Causes and Effects of Delays in Indian Construction Projects” *International Research Journal of Engineering and Technology*, Volume:03, no: 04, pp- 1831-1837.
- [3] Rajakumar A C(2016), “Analysis of Cost Overrun in Road Construction Activities” *International Research Journal of Engineering and Technology*, Volume 03, no. 04, pp- 1433-1439.
- [4] Naveenkumar.G.V, Prabhu.V(2016),“Factors Influencing Time and Cost Overruns in Construction Projects” *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 5, no. 4, pp-6468-6473.
- [5] S. Morris, “Cost and time overruns in public sector projects,” *Economic and Political Weekly*, vol. 25, no. 47, pp. M154-M168, 1990.
- [6] B. Himansu, “Avoid cost overrun for megaprojects,” *Project and Technology Management Foundation News Letter*, 2011, DLF City, India, p. 2.
- [7] B. Flyvbjerg, N. Bruzelius, and W. Rothengatter, *Megaprojects and Risk: An Anatomy of Ambition*, Cambridge: Cambridge University Press, 2003.
- [8] H. S. Heon *et al.*, “Analyzing schedule delay of mega project: Lessons learned from Korea train express,” *IEEE Transactions on Engineering Management*, vol. 56, no. 2, pp. 243-256, 2009.
- [9] E. W. Merrow, L. M. McDonnell, and R.Y. Arguden, *Understanding the Outcomes of Megaprojects: A*

- Quantitative Analysis of Very Large Civilian Projects*, Rand Corporation, 1988.
- [10] D. H. Pickrell, *Urban Rail Transit Projects: Forecast Versus Actual Ridership and Cost*, Department of Transportation: Washington, D.C., 1990, p. 164.).
- [11] D. H. Pickrell, "A desire named streetcar fantasy and fact in rail transit planning," *Journal of the American Planning Association*, vol. 58, no. 2, pp. 158-176, 1992.
- [12] C. C. Cantarelli, B. Flyvbjerg, and S. L. Buhl, "Geographical variation in project cost performance: The Netherlands versus worldwide," *Journal of Transport Geography*, vol. 24, pp. 324-331, 2012.
- [13] R. Singh, "Delays and cost overruns in infrastructure projects: an enquiry into extents, causes and remedies," Working papers 181, Centre for Development Economics, Delhi School of Economics, 2009.
- [14] R. Singh, "Delays and cost overruns in infrastructure projects: extent, causes and remedies," *Economic & Political Weekly*, vol. 45, no. 21, pp. 43, 2010.
- [15] J. Odeck, "Cost overruns in road construction-what are their sizes and determinants?" *Transport Policy*, vol. 11, no. 1, pp. 43-53, 2004.
- [16] C. C. Cantarelli, "Cost Overruns in Large-Scale Transport Infrastructure Projects: A theoretical and empirical exploration for the Netherlands and worldwide," TRAIL Research School, Delft University of Technology, p. 198, 2011.
- [17] OECD, (Organization for Economic Cooperation and Development) *Emission scenario document on plastic additives. Series on emission scenario documents, No. 3*.
- [18] C. Cantarelli *et al.*, "Different cost performance: different determinants?: The case of cost overruns in Dutch transport infrastructure projects," *Transport Policy*, vol. 22, pp. 88-95, 2012.
- [19] C.C. Cantarelli *et al.*, "Characteristics of cost overruns for Dutch transport infrastructure projects and the importance of the decision to build and project phases," *Transport Policy*, vol. 22, pp. 49-56, 2012.
- [20] A. H. Memon, I. A. Rahman, and A. A. A. Azis, "Time and cost performance in construction projects in southern and central regions of Peninsular Malaysia," *International Journal of advances in applied sciences*, vol. 1, no. 1, pp. 45-52, 2012.
- [21] O. J. Ameh, A. A. Soyngbe, and K. T. Odusami, "Significant factors causing cost overruns in telecommunication projects in Nigeria," *Journal of Construction in Developing Countries*, vol. 15, no. 2, pp. 49-67, 2010.
- [22] B. Flyvbjerg, M. K. Skamris Holm, and S. L. Buhl, "What causes cost overrun in transport infrastructure projects?" *Transport Reviews*, vol. 24, no. 1, pp. 3-18, 2004.
- [23] S. Durdyev, S. Ismail, and N. A. Bakar, "Factors causing cost overruns in construction of residential projects: case study of Turkey," *International Journal of Science and Management*, vol. 1, no. 1, pp.3-12, 2012.
- [24] N. Azhar, R. U. Farooqui, and S. M. Ahmed, "Cost overrun factors in construction industry of Pakistan," in *Proc. First International Conference on Construction in Developing Countries (ICCIDC-I), Advancing and Integrating Construction Education, Research & Practice*, 2008.
- [25] Y. Rosenfeld, "Root-cause analysis of construction-cost overruns," *Journal of Construction Engineering and Management*, vol. 140, no. 1, pp. 04013039, 2013.
- [26] F. S. Allahaim and L. Liu, "Causes of cost overruns on infrastructure projects in Saudi Arabia," *International Journal of Collaborative Enterprise*, vol. 5, no. 1-2, pp. 32-57, 2015.
- [27] P. Koushki, K. Al- Rashid, and N. Kartam, "Delays and cost increases in the construction of private residential projects in Kuwait," *Construction Management and Economics*, vol. 23, no. 3, pp. 285-294, 2005.
- [28] G. D. Creedy, M. Skitmore, and J. K. Wong, "Evaluation of risk factors leading to cost overrun in delivery of highway construction projects," *Journal of Construction Engineering and Management*, vol. 136, no. 5, pp. 528-537, 2010.
- [29] A. Enshassi, J. Al-Najjar, and M. Kumaraswamy, "Delays and cost overruns in the construction projects in the Gaza Strip," *Journal of Financial Management of Property and Construction*, vol. 14, no. 2, pp. 126-151, 2009.
- [30] S. Jackson, "Project cost overruns and risk management," in *Proc. Association of Researchers in Construction Management 18th Annual ARCOM Conference, Newcastle, Northumber University, UK*, 2002.
- [31] P. F. Kaming *et al.*, "Factors influencing construction time and cost overruns on high-rise projects in Indonesia," *Construction Management & Economics*, vol. 15, no. 1, pp. 83-94, 1997.
- [32] H. Alinaitwe, R. Apolot, and D. Tindiwensi, "Investigation into the causes of delays and cost overruns in Uganda's public sector construction projects," *Journal of Construction in Developing Countries*, vol. 18, no. 2, pp. 33, 2013.
- [33] L. Baloyi and M. Bekker, "Causes of construction cost and time overruns: The 2010 FIFA World Cup stadia in South Africa," *Acta Structilia*, vol. 18, no. 1, pp. 51-67, 2011.
- [34] N. R. Mansfield, O. Ugwu, and T. Doran, "Causes of delay and cost overruns in Nigerian construction projects," *International Journal of Project Management*, vol. 12, no. 4, pp. 254-260, 1994.

- [35] Y. Frimpong, J. Oluwoye, and L. Crawford, "Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study," *International Journal of Project Management*, vol. 21, no. 5, pp. 321-326, 2003.
- [36] C. Kaliba, M. Muya, and K. Mumba, "Cost escalation and schedule delays in road construction projects in Zambia," *International Journal of Project Management*, vol. 27, no. 5, pp. 522-531, 2009.
- [37] J. Alsuliman, G. Bowles, and Z. Chen, "Current practice of variation order management in the Saudi construction industry," in *Proc. 28th Annual ARCOM Conference*, S. D. Smith, Ed., 2012, Association of Researchers in Construction Management: Edinburgh, UK..
- [38] S. A. Assaf *et al.*, "The management of construction company overhead costs," *International Journal of Project Management*, vol. 19, no. 5, pp. 295-303, 2001.
- [39] R. H. Clough and G. A. Sears, *Construction Contracting*, New York: Wiley, 1994.
- [40] F. M. Arain, L. S. Pheng, and S. A. Assaf, "Contractors' views of the potential causes of inconsistencies between design and construction in Saudi Arabia," *Journal of Performance of Constructed Facilities*, vol. 20, no. 1, pp. 74-83, 2006.
- [41] Sonil Nanda, Smiti Snigdha Sahu, Jayanthi Abraham. Studies on the biodegradation of natural and synthetic polyethylene by *Pseudomonas* sp. *J Appl Sci Environ Manage* 2010; 14(2): 57-60.
- [42] D. Kahneman and A. Tversky, *Prospect Theory: An Analysis of Decision under Risk*, *Econometrica*, vol. 47, no. 2, pp. 263-291, 1979.
- [43] D. Lovallo and D. Kahneman, "Delusions of success," *Harvard Business Review*, vol. 81, no. 7, pp. 56-63, 2003.
- [44] K. V. Patel and C. M. Vyas, "Construction material management on project sites," in *Proc. National Conference on Recent Trends in Engineering & Technology*, 2011, B.V.M. Engineering College, Gujarat, India.
- [45] E. W. Merrow, *Industrial Megaprojects: Concepts, Strategies, and Practices for Success*, John Wiley & Sons, 2011.
- [46] N. R. Roxas and S. Chalermpong, "Forecasting inaccuracies in transportation projects in selected South East Asian countries," in *Proc. 16th Annual Conference of the Transportation Science Society of the Philippines*, Philippines, 2008.
- [47] Y. C. Yong and N. E. Mustafa, "Clients, consultants and contractors' perception of critical success factors for construction projects in Malaysia," in *Proc. 27th Annual Conference of the Association of Researchers in Construction Management*, 2011, Bristol, United Kingdom: ARCOM.
- [48] Alkass, S., Mazerolle, M., and Harris, F. (1996). Construction delay analysis techniques. *Journal of Construction Management and Economics*, 14, 375-394.
- [49] Arditi, D. and Patel, B. K. (1989) Impact analysis of owner-directed acceleration. *Journal of Construction Engineering and Management*, Vol. 115, No. 1, pp. 114-157
- [50] Arditi D, and Pattanakitchamroon T. (2006) Selecting a delay analysis method in resolving construction claims. *International Journal of Project Management*, Vol. 24, pp. 145-155.
- [51] Arditi, D., and Robinson, M. A. (1995). Concurrent Delays in Construction Litigation. *Journal of Cost Engineering*, 37(7), 20-30.