

Evaluation of Infrastructure Project Delay and Delay Based Conflict Management Through Gametheory

P S Sabari Vennila

PG Scholar, Construction Engineering and Management, Department of Civil Engineering, Arunachala College of Engineering for Women, Kanniyakumari, Tamil Nadu-629203, India

To Cite this Article

P S Sabari Vennila "Evaluation of Infrastructure Project Delay and Delay Based Conflict Management Through Gametheory", *International Journal for Modern Trends in Science and Technology*, Vol. 05, Issue 11, November 2019, pp: 63-69.

Article Info

Received on 14-October-2019, Revised on 28-October-2019, Accepted on 30-October-2019, Published on 06-November-2019.

ABSTRACT

Completion of construction project on time is also an important factor in a project. Delay in a project can also lead to conflict, which will result in the increase of cost. In such a situation proper decision making should be done, to avoid such conflicts and cost increase. The paper analyzes construction project delays by using program and evaluation review technique (PERT) and delay based conflicts management through game theory. PERT is a technique adopted by organizations to analyze and represent the activity in a project, and to illustrate the flow of events in a project, and also it is a method to evaluate and estimate the time required to complete a task within deadlines. Game theory is a method, which is used in competitive or cooperative position to find optimal choices that will lead to the desired outcome.

KEYWORDS: Project delay, PERT method, conflicts, Game theory

Copyright © 2019 International Journal for Modern Trends in Science and Technology
All rights reserved.

I. INTRODUCTION

Delay is one of the most common, costly and risky problem in a project, and also leads to conflicts among the people involved in such project. It will happen in almost all projects due to the miscommunication between contractors, subcontractors, property owners or any other reasons. In many cases, construction projects are delayed because of inaccurate estimate of time and project cost that was initially presented to the clients or project owners. Delays and cost overruns are the most common problems causing delay in the construction industry in both developed and developing countries. Proper

scheduling will lead to good time management in a project. But the perfect schedule will not be possible without good delay analysis. In this project, the road construction project and their activities are analyzed through PERT method for delay management. Sometimes conflicts may lead to delay, and delay may lead to conflicts. Thus here game theory is applied for delay based conflicts analysis and management in a project.

II. PROJECT DELAY

The late completion of a project is a common problem that happened to many construction projects which can be a thing that either contractor or client cannot avoid during

construction project. Delays in construction will surely cause money and time overrun. A lot of factors can contribute to construction delays. Mainly it is divided into two. They are

- Internal causes (client, designers, contractors and consultants)
- External causes (government, suppliers, or weather)

To reduce the severe impact on construction projects that come from the factor of delays, a mitigation action should be proposed.

III. THE PROGRAMME EVALUATION AND REVIEW TECHNIQUE (PERT)

Program evaluation and review technique is a statistical tool used in project management, which was designed to analyze and represent the tasks involved in completing a given project. First developed by the United States Navy in the 1958, it is commonly used in conjunction with the critical path method in the year 1957

IV. CONSTRUCTION PROJECT CONFLICTS

The construction industry often focused as a project based industry that is assigned by the unique characteristics of each project and the involvement of the various parties within the project life cycle. Due to the diversity of the industry and the involvement of various parties, conflicts and disputes do take place. Conflicts can be interpreted a disagreement between two or more members of organizations or groups within the organization that arise because they have to use scarce resources jointly, or carry out activities together, or have the status, goals, values, and perceptions is different .

V. GAMETHEORY IN CONFLICT MANAGEMENT

Game theory is a method originated from the mathematical sciences in which is used in competitive or cooperative position to find optimal choices that will lead to desired outcome. That is used in applied mathematics, social sciences, most considerably in economics, as well as in biology, engineering, political science, international relations, computer science and philosophy.

VI. SCOPE AND OBJECTIVES OF THE PROJECT

The observation on delaying factors and delay management is required to complete the project on time with better quality and economical in the construction industry.

- To identify the activities which have much possibilities to create delay in infrastructure construction project.
- To identify ,how much game theory is applicable in construction project conflict management.

VII. LITERATURE REVIEW

The review made on the papers that include the factors which causes delay and the methods adoptable in delay management. Conflict management is also considered as a part the paper.

Jose Ramon San Cristobal(2014), 'Cost allocation between activities that have caused delays in a project using game theory'.

This paper proposes a method based on game theory and applies it to a road building project, in order to identify the activities that are responsible for the delay of the project and divide the costs among them. Using the model presented in this paper, a wide variety of project situations can be modelled and placed as contractual obligations. The number of variables, equations, and inequalities needed to model these real-life situations will depend on the complexity of the problem. There is a general consent between theorists that Game theory provides, by its very nature, the appropriate tools for the analysis and eventual solution of conflicts of any kind. The course of a conflict as well as its resolution depends on the decisions made by the various actors involved. Each party, when considering its decisions, should take into account the decisions made by all the other parties. Game theory is a natural tool that can be used in such interactive situations where the results of the interaction depend on all the players decisions. Using the model presented in this paper, a wide variety of project situations can be modeled and placed as contractual obligations when drafting the contract.

Mukesh Pandey, SagarSoni, Sohit Agrawal(2017), 'Conflicts and Disputes in Construction Projects: An Overview'

Construction industry showing remarkable progression throughout the country, due to increasingly complex and fast-track construction projects; several projects are facing major problems like conflicts and dispute occurrence. If these are not resolute quickly they can worsen causing delays in schedule which results to claims

that needs lawsuit measures to resolve them, loss of money & time. The main motto of this paper is to outcast the factors which are responsible for conflicts & dispute. The paper results good communication facility may give better result. construction industry is critical in nature therefore, it is difficult, but not impossible to minimize their effect by proper management and to better communication among participants.

Jurajgabrhel, katerinahrazdilovabockov(2015), 'The use of game theory to eliminate communication risks of creative activities in project management'.

The project success relies on many factors. But none of them has such an importance as the creative thinking in project communication. This paper discusses the importance of properly set up of communication strategy in project management. It mentions the importance of the impact of creativity on the correct formulation and implementation of communication strategy. Next, it describes one of the less known methods of creativity in communication - game theory. It illustrates the effect of the creative methods on the success of communication with all involved persons in the project. The project results, a well-defined communication strategy built on the principles of game theory may reduce or eliminate the probability of risk (problem) creation. It also helps thinking about the bigger picture.

Mohammed Kishk and OmaymaHashimMotaleb (2015), 'Controlling the Risk of Construction Delay in the Middle East: State-of-the-Art Review'.

The objective of this study is to conduct a literature review to identify additional effective measures for controlling the potential delays risks in construction projects in order to maximize the opportunities for success in those projects. This survey reveals that 60% of the studies are related to decisionmaking, performance, risk management variations and poor management knowledge of stakeholders and that 20% of these studies are undertaken in the Middle East.

LaveenSundararaj, Dr. PalanisamyVellaiyan(2012), 'Delay Tolerant Networking routing as a Game Theory problem -An Overview'.

This paper explores the theoretical approach to improve existing Delay and Disruption Tolerant Networking routing algorithms using Game Theory. Game Theory is a systematic study of strategic interaction among

rational individuals. DTN deals with networks in challenged environment. DTN focuses on deep space to a broader class of heterogeneous networks that may suffer disruptions, affected by design decisions such as naming and addressing, message formats, data encoding methods, routing, congestion management and security.

JolantaTamosaitiene, Oleg Kaplinski (2010), 'Game theory applications in construction engineering and management'.

The article presents review of 42 years of scientific work of Professor FriedelPeldschus in the fields of game theory application in construction engineering and management. A review of scientific achievements and activity of Professor FriedelPeldschus, focusing on his research. Game theory usually analyses decision-making processes in various fields. There are different methods of solving decision related problems. Game theory focuses on problem solution from one player's point of view, while game theory emphasizes its analysis in the interaction among many players. Much of game theory is concerned with finite, discrete games, which have a finite number of players, moves, events, outcomes, etc. Many researchers in different research fields' work applied the game theory in: construction engineering, management area.

Review showed that many researchers in different research fields' work applied the game theory in: construction engineering, management area. It is clear from the review of games theory applications that Professor FriedelPeldschus has had an essential contribution in its development and practical applications in construction industry.

Shabirhussainkhahro, Taushahussainali(2014), 'Causes leading to conflicts in construction projects: A view point of Pakistani construction industry(2014)'. This study focuses on the identification of different direct and indirect causes leading towards conflicts which are usually taking place in construction industry of Pakistan. The direct and indirect causes of conflicts were identified through a detailed literature review and later on, shaped in to a questionnaire to get the expert opinion. The results of this study shows that Delay in payment, Contractual claims, Public interruption, Poor communication, Differing site conditions, Lack of funds, Unclear risk allocation are the direct causes leading to the conflicts followed by the indirect causes. It is concluded that special attention should be given to these factors during the life cycle of the construction project so as to avoid conflicts.

Jose Ramon San Cristobal (2016), 'The use of Game Theory to solve conflicts in the project management and construction industry'.

A typical construction project involves a wide range of disparate professionals, in many cases geographically distributed, working together for a relatively short period of time on the design and construction of a facility. Since organizations are becoming flatter, culturally rich, geographically diverse and intensely competitive, the possibilities for conflict in such environments are greater. Negotiation is an important aspect of a project and plays an important role in resolving claims, preventing disputes, and keeping a harmonious relationship between project participants.

Faisal Sheikh Khalid Ahmad Farhan Roslan , FikriHasmori,MuhammadIlias Said, MohdHanif Ismail, RafikullahDeraman, Nor Haslinda Abas, Sasitharan Nagapan, (2018), 'Significant Factors of Construction Delays Among

Contractors in Klang Valley and its Mitigation'.

considering all viewpoint from various parties that involves in construction process such as contractors, client, consultant and others, this research identified the major factor that contributes to delays in Klang Valley, Malaysia. Questionnaires were distributed among respondents that involved in construction project in Klang Valley. The process of data analysis was conducted by using descriptive statistic that ranked the mean value of factors that contributes to delays. By using the ranking method, financial difficulties were recognized as the most significant factor that caused delays. Thus, by using the same method, some mitigation action has been proposed in order to avoid time overrun in construction.

Kristal Jameson (2005) , 'Game Theory and its Applications'.

Game theory is the mathematical study of strategic decision making in situations of conflict. Game theory has many applications in subjects such as economics, international relations and politics, and psychology as it can be used to analyze and predict the behavior and decisions of the players.

Nuhu Braimah(2013), 'Construction Delay Analysis Techniques—A Review of Application Issues and Improvement Needs'.

A major source of the disputes lies with the limitations and capabilities of the techniques in their practical use. Developing a good knowledge of these aspects of the techniques is of paramount importance in understanding the real problematic issues involved and their improvement needs. This paper seeks to develop such knowledge and understanding (as part of a wider research work) via: an evaluation of the most common DATs based on a case study, a review of the key relevant issues often not addressed by the techniques, and the necessary improvements needs. The evaluation confirmed that the various techniques yield different analysis results for the same delay claims scenario, mainly due to their unique application procedures.

Raj Kapur Shah(2016), 'An exploration of causes for delay and cost overruns in construction projects: case study of australia,malaysia&ghana'.

The paper is aimed to discover the most influence factors causing the project delay and cost overruns and recommend the possible measures by investigating case studies in three different countries in the world. Each country's quantitative data from the past studies was selected to analyse and recommend the effective measures. A questionnaire survey was conducted in all three case studies adopting different data collection strategy.

Ni Yaoa, Yue Wenzeb(2013), 'Analysis of Game Theory Application in the Land Acquisition of Major Projects in China's Urban Area'.

In this paper, the author utilizes the game theory to analyze the interest expression, game strategies and the inter-game relation of stakeholders including government, developers ,land-contributing units and citizens in the major projects. Then the game model is built to focus on the game relations between the government and land-contributing units as well as citizens, aiming to identify factors that promote the balance. Finally, the game solutions are proposed.

Adam Kristowski ,BeataGrzyl and Magdalena Apollo (2019),

'Application of Game Theory to Conflict Management in a Construction Contract'.

The aim of this paper is to indicate the optimal strategy from the GC viewpoint in a conflict situation with the IN. The article presents a list of the most common causes of conflict between parties of a construction work contract, defines

the background of the problem and the cause of the dispute, and subsequently the authors generate a theoretical model of the game. Based on the analyzed game model, the expected payoffs for players were calculated and the probability boundary value determined in making the GC apply. The study results show that while the probability of issuing a judgment favorable for the GC is at least equal to 0.69 it is justified to use an aggressive strategy.

Hiren Rathod Sharma, Nancy Dangrochiya (2005), "A review on causes of disputes in construction industry".

Disputes have become an endemic feature of the Indian construction industry. If they are not resolved promptly they can escalate causing schedule delays, lead to claims that require litigation proceedings for resolution and destroy business relationships. The competitive nature and contractual complexity inherent within construction can aggravate the incidence of disputes.

Research over the last two decades has revealed that factors such as scope changes, poor contract documentation, restricted access, unforeseen ground conditions, and contractual ambiguities are contributors of disputes. While this is widely known, disputes still prevail over such issues. One of the greatest challenges facing the construction industry during the last couple of decades has been how to resolve disputes arising in construction contracts' in a timely and efficient manner with minimal financial costs, without hindering the preplanned end results on a construction project.

Fauwaz Parkar, Magar, Rajendra B. Shaikh, Sameer (2016), 'Claims and Disputes in Construction Projects'.

This study provides an introduction to the claim management and dispute resolution techniques that are frequently encountered in the construction industry. Because of the substantially increasing number of construction claims nowadays, the implementation of the effective construction claim and dispute management is needed. Disputes between the parties to construction projects are of great concern to the industry. Both the study of construction industry disputes, and the causes of those disputes, is essential. It can be concluded that construction disputes are a cause of concern in every construction project and the solution to this problem is to avoid and cautiously manage them for smooth running of construction process.

The fundamental conclusion from this study is that "people" hold the key to avoiding contract disputes.

Adnan Enshassi, Asmahan Jubeh (2008), 'Delay Analysis Methods and Factors Affecting their Selection in the Construction Industry in Gaza Strip'.

This paper aims to survey the commonly used DAMs and to determine the factors that influence their selection according to contractors and consultants perspectives in Gaza Strip. A total of 100 contractors and consultants were approached, of which 33 participated. The results indicated that, the most commonly used DAM in Gaza Strip is "As-planned vs. As-built".

David Yates (2002), 'Reducing the Incidence of Claims and Disputes in

Construction Contracts'.

The causes of claims and disputes are examined from the perspective of transaction cost economics theory due to its focus on contracting problems and in particular its suitability for complex, long-term and dynamic relationships which are found in construction contracts. Conclusions are drawn that the actual incidence of claims and disputes is largely governed by the client in determining the balance of his priorities for the project and his consequent selection of procurement system, and design and construction teams.

Jolanta Tamosaitiene and Oleg Kaplinski (2010), 'Game theory applications in construction engineering and management'.

The article presents review of 42 years of scientific work of Professor Friedel Peldschus in the fields of game theory application in construction engineering and management. A review of scientific achievements and activity of Professor Friedel Peldschus, focusing on his research.

Ary Samsura PhD., Prof. dr. Erwin van der Krabben (2010), 'A Game

Theoretical Approach to Analysis of Value Capturing Implementation Research'.

This paper presents the discussion of implementing value capturing as internalization mechanisms for the externalities by relying on concepts and notions drawn from game theory. A game theoretical approach provides a way to formalize the interdependency and cooperation

among stakeholders in complex decision-making projects, as well as to examine the structure of individual decisions with regard to the implementation of value capturing.

VIII. CONCLUSION

The various literatures related to delay analysis and game theory were collected and studied on the basis of construction industry. Programme evaluation and review technique plays an important role in analysing, expected project completion time, probability of completion before a specified date, activity start and end dates in a construction project. By which proper measures can take to avoid delay in a construction project. And game theory appliance in construction conflict management is also studied. Through which study, its clear, delay based conflicts and their management can be done by means of game theory through getting beneficial solution alternative among options.

REFERENCES

- [1] Jose Ramon San Cristobal(2014), 'Cost allocation between activities that have caused delays in a project using game theory'.
- [2] Mukesh Pandey, SagarSoni, Sohit Agrawal(2017), 'Conflicts and Disputes in Construction Projects: An Overview'
- [3] Jurajgabrhel, katerinahrazdilovabockov(2015), 'The use of game theory to eliminate communication risks of creative activities in project management'.
- [4] Mohammed Kishk and OmaymaHashimMotaleb (2015), 'Controlling the Risk of Construction Delay in the Middle East: State-of-the-Art Review'.
- [5] LaveenSundararaj ,Dr. PalanisamyVellaiyan(2012), 'Delay Tolerant Networking routing as a Game Theory problem –An Overview'.
- [6] JolantaTamosaitiene ,Oleg Kaplinski1 (2010), 'Game theory applications in construction engineering and management'.
- [7] Shabirhussainkhahro,Taushahussainali(2014), 'Causes leading to conflicts in construction projects:A view point of Pakistani construction industry(2014)'.
- [8] Jose Ramon San Cristobal (2016), 'The use of Game Theory to solve conflicts in the project management and construction industry'.
- [9] Faisal Sheikh Khalid Ahmad Farhan Roslan , FikriHasmori,MuhammadIlias Said, MohdHanif Ismail, RafikullahDeraman, Nor Haslinda Abas, Sasitharan
- [10] Nagapan, (2018), 'Significant Factors of Construction Delays Among Contractors in Klang Valley and its Mitigation'.
- [11] Kristal Jameson (2005) , 'Game Theory and its Applications'. Nuhu Braimah(2013), 'Construction Delay Analysis Techniques—A Review of Application Issues and Improvement Needs'.
- [12] Raj Kapur Shah(2016), 'An exploration of causes for delay and cost overruns in construction projects: case study of australia,malaysia&ghana'.
- [13] Ni Yaoa, Yue Wenzeb(2013), 'Analysis of Game Theory Application in the Land Acquisition of Major Projects in China's Urban Area'.
- [14] Adam Kristowski ,BeataGrzyl and Magdalena Apollo (2019), 'Application of Game Theory to Conflict Management in a Construction Contract'.
- [15] Hiren Rathod Sharma ,Nency Dangrochiya1(2005), "A review on causes of disputes in construction industry".
- [16] FauwazParkar, Magar , RajendraB.,ShaikhSk Sameer (2016), 'Claims and Disputes in Construction Projects'.
- [17] Adnan Enshassi , AsmahanJube(2008), 'DelaAnalysis Methods and Factors Affecting their Selection in the Construction Industry in Gaza Strip'.
- [18] David Yates (2002), 'Reducing the Incidence of Claims and Disputes in Construction Contracts'.
- [19] JolantaTamosaitiene and Oleg Kaplinski (2010), 'Game theory applications in construction engineering and management'.
- [20] ArySamsura PhD., Prof. dr. Erwin van der Krabben(2010), 'A Game
- [21] Theoretical Approach to Analysis of Value Capturing Implementation trial Research'. Merrill and Peter g.,(2007), 'Handling Construction Disputes'.
- [22] Shanmugapriya S., Subramanian K.(2013), 'Investigation of significant factors influencing time and cost overruns in indian construction project'.
- [23] Mohammad Abedi (2011), 'Effects of Construction Delays on Construction Project Objectives'.
- [24] Abu Hammad , ., Alhaj Ali , Ayman A., Rateb J., Souma Ghaleb J., Sweis , and SweisStatistical(2009), 'Statistical analysis on the Cost and Duration of Public Building Projects'.
- [25] Simon Tolson(2005), 'Disputes in the construction industry'.
- [26] ChikasiObodoh P., Obodoh(2016), 'Causes and Effects of Construction Project Delays in Nigerian Construction Industry'.
- [27] HipeD.,KeithLiping Fang W.,MarcKilgourl(2010), 'The graph model for conflict resolution'.
- [28] By Rene A., David J., Harmelink and Yamin (2001), 'Comparison of linear scheduling model (LSM) and critical path method (CPM)'.
- [29] Aftab Hameed Memon, Ahmad TarmiziAbd Karim ,Ismaaini Ismail, Ismail Abdul Rahman (2013), ' Comparative study of time management practices in construction industry between Kedah and Kelantan'.
- [30] Carolina Bernardos,MiguelMediavilla, Sandra Martínez(2015), 'Game
- [31] Theory and Purchasing Management: An Empirical Study of Auctioning in the Automotive Sector'.
- [32] Christian von Hirschhausen , JakobReif and Markus Siehlow(2014), 'Using Methods of Cooperative Game Theory for Water Allocation Management in the Orange Senqu River Basin'.
- [33] Anderson,BrianPolkinghorn ,Lee 1(2010), 'Managing Conflict in Construction Megaprojects: Leadership and Third-Party Principles'. Anita Rauzana(2016), 'Causes of Conflicts and Disputes in Construction Projects'.
- [34] Syjyejuo(2002), 'Identification and Resolution of Work Space Conflicts in Building Construction'.
- [35] John ConlinArkadyRetik(1997), 'The applicability of project management software and advanced IT techniques in construction delays mitigation'.
- [36] Mohan M Kumaraswamy(1997), 'Conflicts, claims and disputes in construction'.
- [37] Abd El-Razek H., Bassioni A and Mobarak(2008), 'Causes of Delay in Building Construction Projects in Egypt'.

- [38] Baiden B.K., Ellis F(2008), 'A Conceptual Model for Conflict Management in Construction firms'.
- [39] Bellal Ahmed Bhuiyan(2016), 'An overview of game theory and some applications'.
- [40] Christopher A., Gorse(2003), 'Conflict and conflict management in construction'.
- [41] Aigbavboa C.O.,Thobakgale M.E. and Thwala W.D(2014), 'Professional's Perception on the Causes and Effects of Disputes in the Construction Industry – A Theoretical Exploration'.
- [42] Natalia Anigbogu(2004), 'Conflict management in Nigerian construction industry'.
- [43] Akbar Marefat, Majid Parchamijalal ,ParvanehShahsavand, (2018), 'Causes of delays in construction industry and comparative delay analysis techniques with SCL protocol'.
- [44] KhaleghBarati, Mohamad AhmadzadeRazkenari, Samad M.E., Sepasgozar(2015), 'The Importance of New Technology for Delay Mitigation in Construction Projects'.
- [45] MohdRosazuwad Bin Mohamad(2010), 'The factors and effect of delay in government construction project'.
- [46] Soo Yong Kim , Van Truong Luu and Viet Thanh Nguyen(2015), 'Delay Factors Affecting the Completion of the Government Construction Projects in Vietnam'.
- [47] AbasalHussainCritical , Fangwei Zhu , Hassan Danial Aslam Shahid
- [48] Hussain and Zaigham Ali (2018), 'Critical delaying Factors: Public Sector Building Projects in Gilgit-Baltistan, Pakistan'.
- [49] AmundBruland ,Ibrahim Mahamid ,Nabil Mohammad Dmaidi(2012), 'Causes of Delay in Road Construction Projects'. Abdullah Alhomidan(2013), 'Factors Affecting Cost Overrun in Road Construction Projects in Saudi Arabia'.
- [50] AzinShakibaBarougha, JavadEmamiSkardib, MojtavaValinejadShoubia,Moohammad (2012), 'Application of Game Theory Approach in Solving the Construction Project Conflicts'.