

Analysis Charts for Considering Delay Occurrence Significance

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Abstract

Background/Objectives: The aim of this paper is to propose a decision support tool for contractors' delay claim analysis and it considers delay occurrence significance and its impress. Contractors delays have been always discussed a subject of conflict in construction projects. Allocation of claim and investigation method is usually an ambiguous term. As common, side effects of delayed activities aren't considered while most delayed works in project need an extra time to accomplish more than initial defined time. **Methods/Statistical Analysis:** Delay measurements cannot be looked upon as crisp data and thus this research has taken a Fuzzy logic look upon the concept. It aims at introducing a novel analysis technique to atone side effects of delayed items which are not contractor's failure. **Findings:** The results are presented based on field studies and will be suit for engineers, practitioners and academic researchers so guidance graphs are provided for analysts who consider contractors' delay claim. **Application/Improvements:** This article found a better way to distinguish between uncertain issues in contractor delay analysis.

Keywords: Chart, Delay, Contractor, Fuzzy Logic, Project

1. Introduction

Delay issue can be traced back to the first project contract signed in the world. This problem has been evaluated since its inception and many books, articles and reports have been written about it and relevant techniques were proposed. Most of published researches are about reasons of project delay and few of them are related to delay claim under practical results. In delay claim analysis, in this case the most expectation is that time extend the exact duration which was intended in initial programming. So theoretical evaluations have not taken in to consideration side effects of delay occurrence and its complications. Thus these kinds of solution has taken mathematical classic form which doesn't consider the operation postpone impression. It not only needs to define new time to do the delayed item but also it requires to extend more than initial duration to return to previous environmental and interoffice situation. As we know halting a part of work at which contractor isn't failure makes subcontractors

or workers start working in another project due to unpredictable problem-solving time, engineers, experts and staff take the day off, we face with weathering and ruining as a result of postponing some uncompleted activities, wage lag that lead to labor strike, being disparaged between material sellers and subcontractors and also other problems that are hidden obstacles when a project is delayed.

Influential factors in delays of projects have been studied¹⁻⁴. Recently, efforts have been focused on the quantitative evaluation of delay.

1.1 Delay Occurrence Factors

In 50th ASC Annual International Conference Proceeding, items that define delay claim are categorized into Schedules Change, Drawing Error, Change Orders, Geotechnical Reports and Others⁵. Also the delay reasons cited as a table that is educed to design changes, changes in scope, labor problem, schedule change, late delivery,

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strike, inflation, payment delays, increased quantity, unavailability of materials and others⁶. Azlan Shah Ali divided that into Labor Shortage, Contractors' Financial Difficulties, Construction Mistakes and Defective works, Coordination Problem, Material Shortage, Poor Site Management⁷. In Charles Teye Amoatey's article it is related to Financial, Resource, Technical, Economic, Environmental, Operational, Government and political, Relationship, Security/safety and Legal issues⁸.

1.2 Categorization the Principal Delay Factors

In his paper Mr. Yates⁹ noted the types of Delay quoted from Mr. Rubin. These are categorized to non compensable excusable, compensable excusable, non excusable, and concurrent.

1.3 Define scope (Factors Consideration in this Paper)

In this article influences of delays are evaluated rather than the delay factors themselves. By meetings and discussion about topic, two classifications are selected as roots of delay reasons in contractors' claims which are excusable and are considered commonly.

1.4 Drawing Error, Change Orders, Design Changes, Increased Quantity

1.5 Payment Delays

2. Methodology

Since this paper aims to find out impact coefficient to recover delay consequences, coding in MATLAB software with fuzzy method and utilization of experts' ideas lead to definition of programming rules that bring useful and certain results. Finally some graphs are generated to show influential coefficients for engineers and experts to utilize in classic results as a coefficient lead to cover hidden obstacles when they want to find real time to execute delayed activities. Some questionnaires distributed between experts who engage in projects and have good experiences about the matter. After gathering answers we recognized a few misunderstandings, so questionnaires have been promoted and also a meeting was hold

to clarify our points and finally the answers were reached a reasonable inconsistency index. Results used as implication rules in fuzzy inference system.

The ambiguity of social judgment has been conceptualized by the fuzzy set theory. The fuzzy set theory provides a formal framework for the presentation of the ambiguity. Fuzzy sets were defined by Zadeh (1965) who also outlined how they could be used to characterize complex systems and decision processes (Zadeh, 1973). Zadeh argues that the capacity of humans to manipulate fuzzy concepts should be viewed as a major asset, not a liability. The complexities in the real world often defy precise measurement and fuzzy logic defines concepts and its techniques provide a mathematical method able to deal with thought processes which are often too imprecise and ambiguous to deal with by classical mathematical techniques.^(Dadios, 2012)

In classic multi-criteria decision making, attempts are made to calculate the effect of different factors using mathematical concepts, but it is impossible to express many factors using mathematical logic. There is always uncertainty in the real world, including during the various stages of studying any issue. Therefore, in many cases all or parts of the data of a multi-criteria decision are fuzzy and, if a problem is formulated using definite data, no correct and accurate answer can be obtained. Consequently, a choice will not be the optimum selection; it is impossible to achieve a set target with such inaccurate decision making. Hence in decision-making models

whose data are random or fuzzy, besides further calculation and operations the model should consider accuracy, logic and uncertainty. Uncertainty in decision making is

modeled using fuzzy set theory, and limitations in classic multi-criteria decision making methods have led to the introduction of fuzzy multi-criteria decision-making.¹¹

3. Conceptions

Given that the factors influencing the claims made by the contractors in delay claims are beyond the Aristotelian logic and this is while criteria could impact less than what it has been regarded as delay days or even are more influential than the time intended for that criterion. For example, in case payment of the statements made for part of a project takes more than a few months, its impacts on

the project is higher than the number of days of non-payment with ordinary mathematical formula calculations, because if we enter the heart of the project we will find that the damages caused by the project recession have a fuzzy definition and therefore are not the result of absolute delays, and in case of short-term payment in spite of the delayed payments must be based on computational formulas and factors such as financial capability, local credit, non-depreciated pre-payment, items under run at the time of delay and other cases items are so effective that the delay time adopted by the employer or owner of the project based on the computational formula has significant differences and those delays may even have no impact on the project at that time and conditions, and also project delays makes the floating and probability of doing activities freely was done in a more compact situation and this needs more serious provisions (González, Vicente González·Keith Molenaar, & and Francisco Orozco, 2014). Hence, using analytical hierarchy process-fuzzy logic, coefficients more than one or less than one are entered to the number of days approved for delays based on the relevant conclusions of the Commission. The significance of this method is that delay analysis through the data entry into programs approved never leads to true result. The structure of schedule due to the complexity of prerequisites and post-requisites make the results unrealistic and the result of some contractors is happy and some unhappy with the approved delays, making the project face with problems for settlement or furtherance. Utilizing fuzzy logic method causes the result of the investigations close to the real situation of the project and different reasons to cover the weakness of Aristotelian logic by the contractors happen less.

4. Define Specification of a Problem

Some causes that their influences are not regarded during consideration delay claims can be listed below. These are selected after various meetings by experienced engineers.

4.1 Durability of Problem

Effects such as expert workers who are vacated their post, local invalidations that came from ponying up lag, Erosion and weathering lead to operational issues and reworks

4.2 Difference between Status of Problem and Ideal Conditions

Impact of problem like serious damages which are caused by natural disasters or reworks because of Order/design changes.

4.3 The Importance of the Involved Member or Section

Although troubles can be severe; they can be a part of secondary member which other important sections are not related directly.

4.4 Process of Project Life Cycle

Troubles in each project life cycle have different impress. For instance, lack of another job front or amount of not depreciated prepaid when the problem happens are difference between the first third and the last one. Even, local validations of contractor areaway.

5. Modeling and Analyzing

Fuzzy model set by designation of parameters which were defined as “specification of a problem” and “scope” before. Fuzzy inference system is created and mamdani implication is selected. Centroid method is set as defuzzification and also Gaussian is defined as membership function. These settings were contemplated on the best results. 27 rules are defined by questionnaires and expert engineers’ answers. Arithmetic mean is used for expert answers. These numbers of rules are determined to make the model with all kinds of probabilities.

5.1 Scope one (Drawing Error, Change Orders, Design Changes, Increased Quantity)

The FIS have three inputs ‘life cycle’, ‘member significance’, ‘problem durability’ and one output ‘effectiveness intensity’. Output shows how much problem is significant that defines by percentage. The figure 1 shows relationship between lifecycle, duration of problem permanency and measurement of effectiveness intensity. Also figure 2 shows relationship between structure significance, duration of problem permanency and measurement of effectiveness intensity. Figure 3 shows fuzzy system design flowchart.

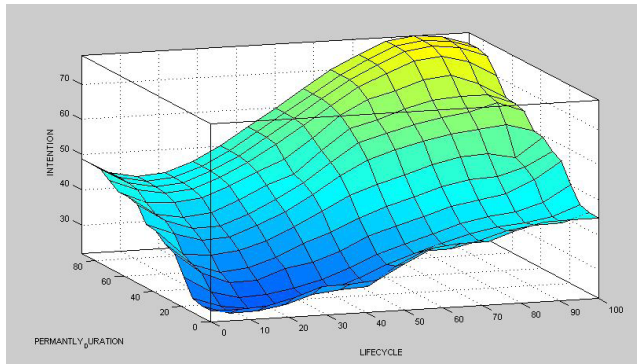


Figure 1. (6.1)

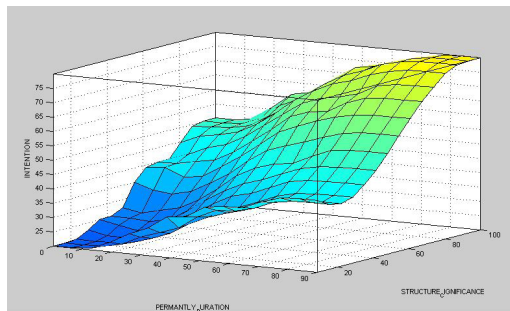


Figure 2. (6.1)

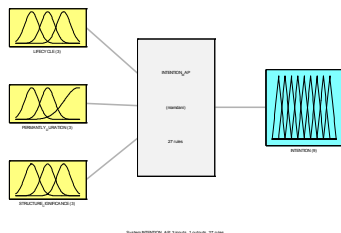


Figure 3. (6.1)

5.2 Scope two (Payment delays)

This part has been done such as scope one but the FIS have three inputs 'life cycle', contractor ability, 'problem durability' and one output 'effectiveness intensity'. Contractor ability is an index that shows how much a contractor can tolerate when the bill payment is postponed. In this paper four parts are determined, when 50% of down payment is used, when 100% of down payment is used, when contractor is spent 50% of its affordability corresponding to bond, most tolerance of contractor. Output shows how much problem is significant that defines by percentage.

6. Results

This result contains most hidden influential matters that come from postponing activities and it is obvious that delayed activities due to latent issues need more time to complete more than initial defined time. These useful charts are provided below.

6.1 Scope 1 (Drawing Error, Change Orders, Design Changes, Increased Quantity)

By using these charts, impact impress coefficient will be extracted on vertical axis. Each chart is defined member of structure significance that divided to low (structure members which are not critical during construction), more than low, less than high and high significance (main structures). Lower curved line is related to the least physical completion of project when schedule is on primary section. Vice versa, upper line shows the most physical completion. So by interpolation, engineers can find the percent of completion of the project under consideration.

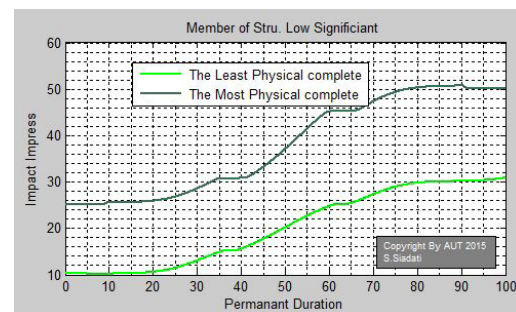


Figure 4. Impact impress coefficient for low significance members.

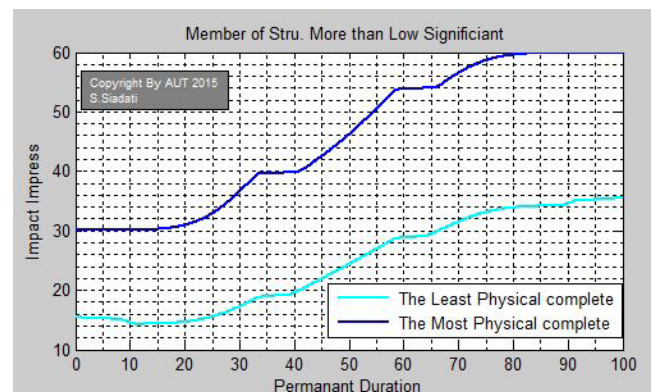


Figure 5. Impact impress coefficient for more than low significance members.

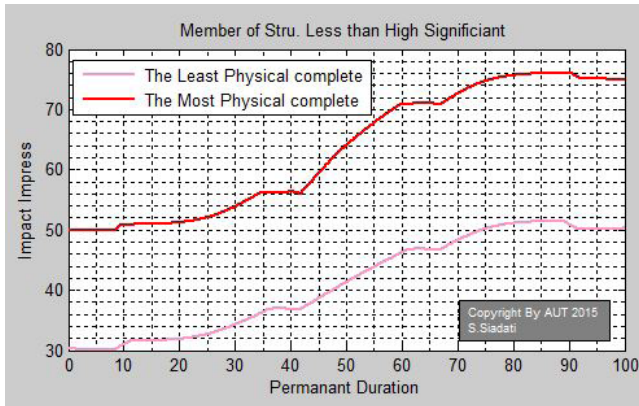


Figure 6. Impact impress coefficient for less than high significance members.

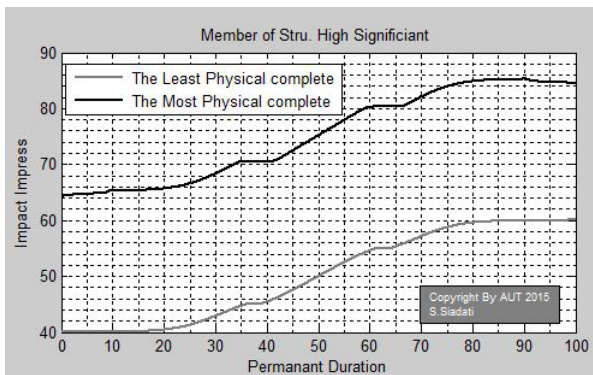


Figure 7. Impact impress coefficient for high significance members.

6.2 Scope 2 (Payment delays)

In this scope, charts are categorized by financial situations in which contractors are engaged, so they are classified to when 50% of down payment is used, when 100% of down payment is used, when contractor is spent 50% of its affordability and the most tolerance of contractor that is defined in contract.

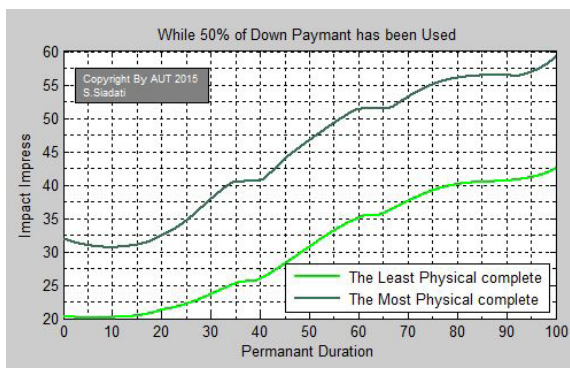


Figure 8. Impact impress while 50% of down payment has been used.

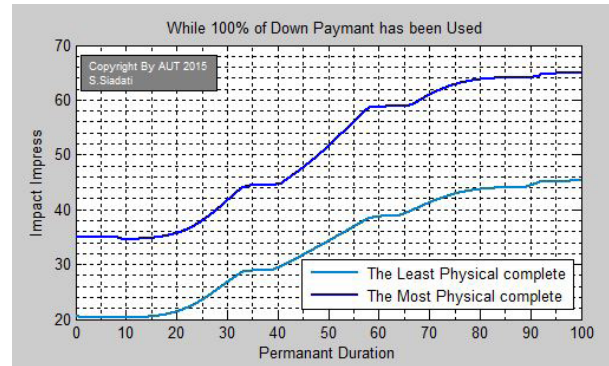


Figure 9. Impact impress while 100% of down payment has been used.

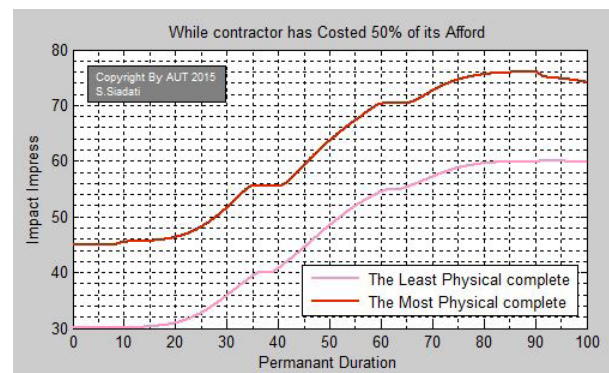


Figure 10. Impact impress while contractor has spent 50% of its affordability.

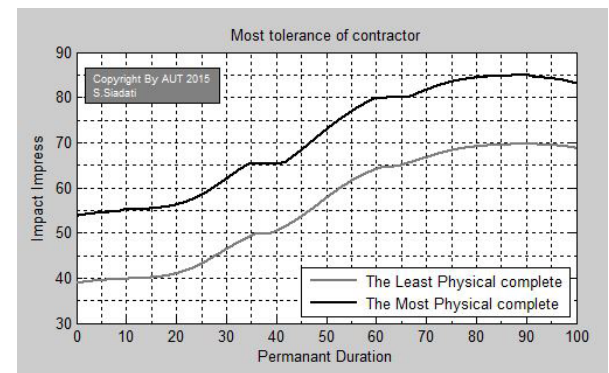


Figure 11. Most tolerance of contractor.

7. Conclusion

In real estimation of delay claim analysis, some hidden causes should be considered. So lots of reasons were investigated and classified in two groups which are excusable and don't come from contractor's failures. Fussy logic as a suitable way to define uncertain issues has been selected and by coding and programming with MATLAB soft-

ware, some charts have been generated that can be utilized in delay claims. Engineers and experts who want to consider contractor's delay can find out impress coefficients from these charts. The coefficient should be multiplied by classic result and the output should be summed to classic answer.

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9. References

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