The Quantity Surveyor adopts the Information Technology to assist the Construction Delay Claims [A Case Study – Computer Generated Imagery (CGI) visualization of construction of Club House]

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Abstract— *The world phenomena is that most of construction project will encounter some form of delay which cause various and complexity of reasons during the process. Generally, the delay are entitled to claim an additional money as compensation but the burden of proof lies with the party making the assertion; thus, Quantity Surveyor as one of technical experts are often employed to undertake and face the challenge on fair judgment*.

The aim of this paper identifies the current practices of claim evaluation and difficulties on decisions and how that Information Technological developments can assist by way of computer generated visualization which is Building Information Modelling (BIM) to support delay claim on fair decision.

The methodology includes for literature review on claim evaluation methods that are in current practice and their shortfalls. Accordingly, computer module would be generated based on Model Houseas a Case Study to show that how the Information Technology would contribute to identify the delay events which would be easy to ascertain the compensation and fair decision by the Quantity Surveyor.

Keywords— **Construction contracts, delay, claim, compensation, assertion, Building Information Modelling (BIM), decision**

I. INTRODUCTION

The Construction means an erection, repair and demolition of all types of buildings and civil engineering structures, Specialist subcontracting trades including hiring contractors' plant and scaffolding (UK SIC, 2007) and those activities are always complex and complicated process (Doyle.,&Hughes.,2000). Murdoch., & Hughes., (2008) stated most of things are due to technological complexity which involving multiple interacting sub-systems; high level of organizational complexity with many specialized skills and professions; wide ranges of events that the industry's external boundaries are also unclear; fragmentation into a large number of diverse skills is an inevitable consequence of the economic, technological and sociological environment and the like. Due to the complication as above most of projects are likely to be encountered time delays (Mitkus S, Mitkus T2013) even though proper contract is governed a project (CEM, 2009). Sambasivam & Soon (2007) highlighted eight (8) factors on delays which are related to – owner; contractor; design; contract; human behaviour; project; external and identified twenty eight (28) numbers significant causes in common project. If any causes are requested to be part of the contract the risk has to be laid on pricing party and anything other than not in and occurs the victim party would entitle a cost under a contractual claim.

If the cost to be claimed of the delay event the contract parties are required to identify the default party on delay and the establishing of applicable cost as 'claim' and victim party is entitled to compensate a claim in terms of contractual obligation. Therefore, a burden of proof lies with the party making the assertion (RICS, 2003). In general an assertion means that analysing the cause and effect of a delay event which is more difficult in a complex of a project; thus, construction technical experts are often employed to identify the assertion but face the challenge of clearly representing and communicating their findings.

This paper identifies comparison of one of common, traditional approach representing in the construction for how to evaluate a delay event and explores how they could be assisted through technical developments in Computer

Generated Imagery (CGI) visualization which would more accurate and reasonable way rather than in traditional approach.

The Club House project, as in-house case study is selected in this report and 'model house' represents true events which was occurred at project. Accordingly, traditional method as 2D and the CGI method as 4D are compared to understand the advantage of new trend application on claim evaluation.

The outcome of the findings are more benefited to open the gate on new research area for the students who are follow the Quantity Surveying degree programme and provide more view towards to amalgamate in Building Information Modelling (BIM) to support delay claim evaluation on their assignment to resolve claim fairly.

II. Legal grounds in compensation in construction contracts

In the law, the contract creates by legally binding agreement which has provision to claim compensation by innocent party on breach of contract through a legal remedy for loss they have suffered from other party (CEM, 2009). Generally, in the construction contract the compensation mainly categorized accordingly to the claiming party (Turner, 2007).

The burden of proof is placed with the claimant to prove a facts by showing on the 'balance of probabilities' through cause and effect (Carnell, 2000) and the balance of probabilities can then be shifted based on the 'standard of evidence'.

A. Delay

The term delay is used in the construction contracts but direct definition is not identifiable even in form of standard conditions of contracts (Pickavance, 2010). Fenwick (2012) stated that the term of delay refers to the non-completion of works by a date set in the construction contract.

Subject to the claiming party, different forms of compensation are available depending on how the delay is categorized (Trauner, 2009). The compensation relates to a client is based on work delay by a contractor and claim can made under an unliquidated or liquidated damages which suffer on a client's investment plan. On the other hand, the contractor would claim an extension of time and/or loss and expense when he feels that delay is beyond his control according to a contractual ground.

In construction contracts the delays can be identified with the help of standard forms of contract and widely applying forms are in Sri Lanka likelyFédérationInternationale des Engénieur – Conseils (FIDIC) Red Book and Standard Bidding Documents (SBD).

According to the FIDIC Red Book, the delay terms as *"… proceed with the Works with due expedition and without delay"* pursuant to clause 8.1 and then delay is identified as any excess time difference between clause 10.1-Taking Over of the Works and clause 8.2-Time for Completion set out the project completion date.

If this difference due to the contractor's default an employer entitle as compensation for his/her lost due to the time overrun and clause 8.7 – Delay Damages set out for the recovery and the employer can claim unliquidated or liquidated damages which protect their investment if the project is not completed by a contractor as per the agreed time period and provision in the contract. In vise versa, the employer is responsible for delays the contractor would get time and cost compensation subject to the clause 8.4 – Extension of Time for completion with very restricted circumstance.

In order for the claimant to receive compensation, a construction delay claim must be made.

B. Claim

The claim can be categorized in one of either contractual, extra-contractual or ex-gratia (CEM, 2009) and further can be differentiated by classes of delay i.e. excusable/compensatable; excusable/non-compensatable;non-excusable/non-compensatable. In this report the limitation are made on contractual claim against excusable/compensatable type of delay and others are excluded.

The Literature Review proves that the UK is the good example to see a claim situation and 70% of UK construction projects are delivered late (HH treasury, 1999) and claim exist which was not accounted in the construction cost and compensations made by victims in order to recover their cost. Sweet & Maxwell (2010) said

that claims are not settled and may go into disputes and risen by a third during the recent recession and EC Harris (2010) shown that value of disputes increasing by US $ 2.7 million and 1.95 months and owing to that extensive resources and divergence of proactive management of the organization to undertake a construction claim as well as the migration of cash flow out of the construction industry when disputes occur and suggested imperative steps to improve a claim process.

In the construction claims, Kumaraswamy (2003) explained that there are various delay analysis methodologies apply to explain the cause and effects on delay on projects and hence numerous lever arch files which will further difficult to understand the situation.

C. Delay analysis

Therefore, the process of analyzing delays can be viewed as the forensic investigation into an issue which has caused the project to overrun on time (Farrow, 20001).

Keane (2006) stated that visual information is better than the oral information as it easy to understand and claimant able to use TIA to interpret what was occurred on the project which the analysis could focus. Even the large quantities of record and information before to the court or arbitration the judge also received quite difficulties to understand. This is apparent in ***Hunte v Bottomley*** where Arden L.J. stated:

"*Those who prepare bundles or skeleton arguments would do well to remember that a plan, map, diagram or photograph which is clear to people who are fully familiar with the case may well not be wholly clear to a judge coming to the case for the first time".*

III. BASIS FOR CLAIM PREPARATION

One of common approaches is that 'Time Impact Analysis (TIA)' which breaks the construction programme into a series of windows with their own baseline… (Arditi, 2006).

The construction Programme is the most common way to represent the cause and effect of delays and a variety of methodologies are currently available to formulate the computer orientated version like – Microsoft Excel; Microsoft Project; Primavera and the like (SLC, 2002). Further, the standard conditions of contracts are also stated as contractor's obligation to produce a construction programme as per clause 8.3 of FIDCI. Due to the fact that the same Programme use to represent claim supporting document to indicate the circumstance of the construction progress. Generally, this Programme retrieve the data on progress of construction against time through the line bar chart which mean 2D visualization.

A. 2D Visualisation

The programme was prepared for the Club House project which named by 'As-planned' as mention in the Annexure – A. As-planned programme was created by using Microsoft Excel based on 'line bar-chart' method to determine the construction activities. This was accepted by the Employer pursuant to clause 8.3 of SBD. According to the clause, the programme shall be submitted within 14 days after receiving the notice of commencement of works and details must be inserted for: intended to carry out works in sequence; contractor's documents, procurement, manufacture of plant, delivery to site, construction, erection and testing; any nominated subcontractor's work; sequence and timing of inspections and tests specified in the contract. Due to the time constrains of submission period the contractor does not attend to prepare in detail programme but the problem create later to identify the proper comparison as common practice in the industry.

There was significant delay time to time in the project and revisions of programme was prepared regular time and example is enclosed in Annexure B.

Soon after completion of the works the programme was created which clearly identify the delay time period in overall and commonly named as 'As-built progamme'. This visualization is based on 2D method and able to demonstrate the exact progress for a point in time.

In order to find out the cause of delays the As-planned and As-built progammes are plotted to one paper and evaluation done accordingly. The As-planned v. As-built submission is illustrated in Annexure C.

B. 4D Visualisation

Currently, the 3D module will be used in the construction industry since inception of the project. It has named Building Information Modeling (BIM) which would helping to facilitate a designer's design development. Using the BIM application a new trend would be applied to evaluate the delay claim by converting it to 4D Visualisation. It was created by a virtual modelling of software package by 'AutoDesk 3D Max'. This would help to claim consultant to

find out the cause(s) which helps evaluate the claim by easy approach. The visualization was linked to an as-built programmewithin the software to create a fourth dimension, time. Under the 4D visualization, the delayed elements were highlighted in red returning back to the original element colour once the delay had passed. The snap shot of a building with 4D visualisation which include red colour to indicate the delay of activities are attached in Annexure D.

IV. EVALUATION OF CLAIM PREPARATION APPROACH

The comparison is based on TIA method which is (2D) approach and 4D application.

A. Review of 2D Visualisation

The 2D visualization provides an easy to understand of the causes of delay on the project based on line bar representation as per the selected elements in the programme. Further it can easily follow the sequential of works which are in the constructions of the project. The sequential line bar 2D visualization while on as-planned v. as-built version by side by side, the visualization demonstrates which elements are delayed for a point in time in relation to all faces of the project. Seeing all faces of the project simplified the understanding of how works progressed in an area and the impact of delay.

There are limitation exist in 2D visualization which enable to show only the element through plane surface in a paper and only provide a record of information activities which are to be executed in vertical form. The linear bar of the event does not represent the volume of work and only length of bar represents the time period. It does not represent the site layout and balance or remaining volume of work to complete. Generally, the programme will be created in a spreadsheet form and difficult to understand by everybody. Therefore, a claim evaluation before the court and not been visited a site it would not an easy task to understand by an evaluation judge and particular team as identify in Hunte v. Bottomley.

Keane (2008) stated that Microsoft Excel is an extremely powerful piece of software which is not developed to assist with construction claims; it is not visualized an eye-catching and may not retain an individual's attention and therefore, limitation exist.

Possible improvement can be from Microsoft Project software package or Primavera software package which still represent the bar line programme. Therefore, it is required additional supportive information such as separate documents to show circumstance in the event and photographs at different time period to show the situation to understand the 2D visualization.

Hence, any advance software could make the visualization more appealing to the eye which can compare against original planned work the mechanism would be comfortable than 2D visualization.

B. Review of 4D Visualisation

The 4D visualization would provide a virtual representation of the construction works in a 3D manner where events, activities and circumstance can execute at site. This allows claim evaluation body to clearly understand the construction site without ever having to visit. Software programme able to pan around the visualization the specific building point or element from any desired angle. When linked to the construction programme, it allows the viewer to virtually see the construction of the building without having to understand the construction programme in detail as challenge encountered in Balfour Beatty Construction v. London Borough of Lambert.

There are limitation exist in this method as well and 4D visualization does not represent as-planned v. as-built progress side by side (Pickavance, 2007). It possible to linked to one visual representation of the works with colour coding depicting elements in delay. So it does provide only the delay and the rate of progress during the construction. Therefore, stop-start relationship of the works is not clear and the delayed elements are not easy to understand. It still unable to links or photographs to assist with better understating.

The 4D visualization can be more materialized in order to generalize for claim evaluation when software to link all information which are in records by enhancing exist software system. Example is that a voice recording for the particular information and link when analysis are on progress hear.

V. RECOMMENDATION

In entertainment industry 'visualizations' are developed by Computer Generated Imagery (CGI) for the internet, television, computer/video games and flim (Parent, 2012). Within the construction industry, visualisations are predominantly used in architectural design, but their

benefits can be realized throughout the construction lifecycle (Bouchlaghem, 2005). Numerous software providers offer products which allow you to virtually construct a construction project. One of this application is Building Information Modelling (BIM). Cabinet Office (2011) in the UK Government has mandated to adopt the BIM application on all public sector construction projects by 2016 as it way of tackling the inefficiencies present in the industry through the process of recording all of a project's information throughout its lifecycle in one, central, electronic, location.

In the construction project the information is linked to a 3D virtual representation of the project which is produced using object based parametric modelling software which determine both geometric and non-geometric properties and features. The relationships and constraints between objects ensure realistic connections between elements and when designed in a single source model, a change to an object in one view will automatically update all other views and linked information (Eastman, 2011). With this application there multiple dimensions can incorporated to a model like 4D (time), 5D (cost) and 6D (FM) and the like (RIBA, 2012), so where a change in any view or dimension will instantly change all dimensions, views and report the most up-to-date information on the project.

Card (1999) stated that information can be a visual representation which can enhance understanding easily. So that the courts are moving to adopt simple methodology which is e-disclosure and the use of screens as a method of communication for legal proceeding which would facilitate the facts on the case (Narayan, 2001). Visualizations have assisted the courtroom in the 1998 UK inquiry into the events of Bloody Sunday in Londonderry in 1972; Carla Terry murder case in Connecticut in 2001 (Gibbs, Emmitt, Ruilcar& Lord, 2012).

V. CONCLUSION

Unfortunately delay claims analysis have not been used an e-disclosure application where already court has adopting (Vidogah, 1998) and Pickavance (2007) and identifying how computer base technology can be used to create animations of tangible construction works to support construction disruption claims.

Therefore, this paper contains that how the delay event in construction can be visualized based on Computer facilitated technology which has more benefits rather than TIA method. (Gibbs, Emmitt, Ruilcar and Lord, 2012)pointed out those benefits as reduction in claim preparation; easy to in build different scenario to evaluate various view on facts, a rise in the quality of sophisticated computer software programme and obtain simple reports accordingly to the different approaches. Even Pickavance (2010) stated that the CGI methods would use in some adjudications & arbitrations; however, its value as evidence will vary depending on how it is employed and the supporting documentation (Schofield, 2005).

Considering all above this research concluded that validation of CGI visualization approach (4D) is better than comparing to the TIA based line programme analysis (2D).

It is now cleared phenomena in the world that construction projects mostly in delay category and the Quantity Surveyor involves to settle delay claims as one of key role which needs to success by applying new trending method.

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ABBREVIATION

CEM – College of Estate Management
FIDIC – Federation Internationale des Ingenieurs-Conseils

ACKNOWLEDGMENT

This research was completed by the Students who are following the BSc degree programme in Southern Campus, KDU under Lecturer's supervision. Students Sirisena ST and Jayathilaka KAIM who had tremendous support to achieve the goal in successfully. Congratulation for Students' team work effort.