# A SYSTEMATIC METHODOLOGY FOR ANALYSING DISRUPTION CLAIMS

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Disruptions to contractor's progress are commonly encountered in most construction projects and often result in productivity loss (or disruption) claims. The standard of proof set by the courts and other dispute resolution mechanisms for the recovery of such claims is onerous. This demand, coupled with the extreme difficulty associated with proving disruption pose a major challenge to practitioners in their resolution. Whilst methodologies for analysing disruptions abound in the literature, their use is found to be unsatisfactory from a number of different aspects, particularly in proving causation. As a contribution to aid practitioners overcome this problem, this paper reports on an on-going research aimed at developing a framework for improving disruption claims analysis. Based on review of the literature, a systematic methodology is proposed for performing the analysis in detailed, clear and equitable manner. Further studies have been designed to validate it and address issues that may affect its acceptability and usability in practice.

Keywords: claims, delay and disruption, extension of time, productivity loss, programming.

# **INTRODUCTION**

The uncertainty, complexity, multiparty and dynamic environment that typify modern construction have led to many projects encountering various problems. The Egan report (Egan 1998) bears testimony to this, stating that recent studies in UK, US and Scandinavian countries suggest that up to 30% of construction is rework, labour is used at only 40-60 % of potential efficiency, accidents can account for 3-6 % of total project costs and at least 10% of materials are wasted. One of the most frequently encountered problems is disruption to contractors' progress, which causes inefficiencies or loss in productivity. Various studies have decried the high incidence of this problem in recent times (Horner *et al.* 1987; Semple *et al.* 1994; Thomas and Oloufa 1995).

The UK's Society of Construction Law protocol on delay and disruption has defined disruption (as distinct from delay) as disturbance or interruption to a contractor's normal working methods resulting in lower efficiency or lost productivity (SCL 2002: 31). A common cause of disruption is therefore changes (or variations), which are often ordered by employers. The negative impacts of changes on labour productivity are well documented in many studies (e.g. Thomas and Napolitan 1995; Ibbs 1997; Hanna *et al.* 1999a; Hanna *et al.* 1999b). The impacts include stop-and-go operations, out-of-sequence work, loss in productive rhythm, demotivation of work force, loss in learning curve, unbalanced crews, excessive labour fluctuations, overtime, and working in adverse weather conditions (Hanna and Heale 1994; Schwartzkopf 1995).

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The occurrence of these events, if caused by the employer, may give rise to a right to compensation under either an express term of the contract or as a breach of contract.

Analysing project disruptions to ensure that the responsible party compensates the claimant for the damages done, is however often recognized as a difficult undertaking at its best (Schwartzkopf 1995; Ibbs 1997). A major cause of the difficulty is the fact that productivity losses are often attributable to multiple events and project participants (Leonard et al. 1988; Hanna and Heale 1994), where the events may occur simultaneously. This makes it difficult to unravel and sort out clearly what is often a tangled web or 'spaghetti' of interrelated issues and problems into their individual causes and effects. The situation is further exacerbated when the contractor's claim includes the unforeseeable impacts or 'ripple' effects of multiple change orders on work not covered by the change instruction. The cumulative (synergistic) impacts of these changes are particularly troublesome to resolve as described by a Construction Industry Institute report (Hester et al. 1991) - "when there are multiple changes on a project and they act in sequence or concurrently there is a compounding effect – this is the most damaging consequence for a project and the most difficult to understand and manage. The net effect of the individual effect of the individual changes is much greater than a sum of the individual parts".

Yet the standard of proof required for contractors to succeed with disruption claims must meet demanding objectives (Shea 1989; Klanac and Nelson 2004). These include presenting the claims using the best evidence available to prove cause and effect relationships of actions or inactions of the parties and making it clear and simple enough for the understanding of all parties involved (Gavin *et al.* 2001: 82). Sadly, each of the existing methodologies for analysing disruption is found to be unsatisfactory from a number of different aspects, particularly in proving cause and effect relationships (Schwartzkopf 1995; Klanac and Nelson 2004). As a contribution to aid practitioners overcome this problem, this paper reports on an on-going research aimed at developing a framework for improving the analysis of disruption claims. Based on review of the literature a systematic methodology is proposed for performing the analysis in detailed, clear and equitable manner. The next stage of the study will focus on its validation and issues of its acceptability and usability in practice.

# A SYSTEMATIC METHODOLOGY FOR ANALYSING DISRUPTION CLAIMS

The common thread running through various texts, research documents and court decisions on construction claims is that for a contractor to satisfactorily recover its productivity losses three main elements must be proved (Lee 1983; Klanac and Nelson 2004):

- (i) Liability the employer was legally responsible for compensable disruption/impacts. These are events, which according to the contract entitle the contractor to compensation for any resulting additional costs.
- (ii) Causation establishing causal link between the impacts and the cost overruns incurred.
- (iii) Resultant injury (or quantum) the cost of the impacts as attributable to the employer's action or lack of it.

The first element is relatively easy to prove than the last two (Klanac and Nelson 2004). The proposed methodology thus focuses on these two challenging elements and does not address the legal aspects required to prove liability. To clearly satisfy the required proofs, the methodology considers two somewhat separate phases - causation and quantum phases. Figure 1 shows a flow chart representing the content of these phases.



Figure 1: Flow chart of the proposed methodology

The causation phase mainly involves the use of detailed project records and cause/effect matrix to establish the causal link between all disruption events and impacts giving rise to extra cost. The quantum phase, however, involve the use of critical path method (CPM) software with the capability of linking activities defined in the programme with their cost. This requires the use of activity-based approach to job costing in order to facilitate cost recordings against activities defined in the programme. The project cost codes should therefore cover all elements of the work in appropriate detail with distinction between operations that exhibit different productivities. Detail discussions of the procedures involved are provided below.

#### **Phase 1- Proving causation**

This phase involves two main steps: Review of project documentation and establishing causal link.

#### Step 1-Review of project documentation

A number of researchers and expert commentators (Bubshait and Manzanera 1990; Cox 1997; Al-Saggaf 1998; Baki 1999) suggest that the first port of call in the analysis of claims is for the analyst to gather and examine all available project information pertinent to the claim. Since disruption claims are more often about information on productivity impacts, the key information that require important examinations include:

- actual project resources utilization (labour, equipment/tools) with their status in the execution of relevant activities, i.e., working or not working-idle or broken down;
- the reasonableness of the baseline programme as to its completeness, level of detail, logic, resource loading and planned productivity rate; and
- change order account and change conditions experienced on the project as a result of employer risk events.

Other important documents that need review include: labour time sheets, manpower histograms, physical progress curves, programme updates, requests for instructions, daily reports, correspondence and payment certificates (Cox 1997). The essence of the review include to confirm the accuracy of the records and also to familiarize with the project's progress at any point in time (Bubshait and Manzanera 1990). Checking for their accurateness is central to proving compensable loss since it is from the records that one can establish the reasons for inefficiencies other than that for which the contractor is responsible. Therefore the records should as far as possible be documented contemporaneously throughout the project life in an accurate and organized manner (SCL 2002).

#### Step 2- Establishing causal link

The next key step is to establish the causal link between the actions or inactions of the parties and their corresponding effects that allegedly have resulted in additional cost. Three main steps involved in achieving this are as follows:

#### Step 2.1- Identify all changes in work conditions

Productivity losses are mainly caused by changes in the contractor's anticipated or planned working conditions, resources or manner of performing its work (Finke 1997). Thus to establish causal link, it is important for the analyst to first identify all changed conditions the project experienced by tracking all variances from the contract such as design interference, out of sequence work and overmanning using project records.

#### Step 2.2 - Develop cause/effect matrix

Cause/effect matrix is a useful analytical tool for demonstrating graphically, a hierarchical analysis of the multiple cause/effect relationships between primary causes and final results in a number of different scenarios (Pickavance 2005: 497). To clearly trace the impact of employer-caused disruptions, the analyst should develop such matrix to illustrate all the causes of the productivity loss including contractor-caused problems. An example of a simple cause/effect matrix is shown in Figure 2. The form of the matrix depends upon the extent of impact experienced, which can be very complex as series of multiple and duplicating effects may have to be shown.



Figure 2: Typical cause/effect matrix

#### Step 2.3 - Prove activities impacts using as-built programme

An as-built CPM programme reflecting the actual duration and sequence of activities should be developed either through regular programme updates or retrospectively using project records. This programme should be detailed enough to show the transpositions of the various stages of individual activities as a result of the disruptions encountered. The various impacts in the cause/effect matrix should then be linked to the various as-built activities. Starting with the first disruption event (a primary cause) the immediate and 'ripple' effects can be tracked through the as-built programme by taking note of resequencing of activities, their logical successors and concurrent activities. Chronologically, the impacts of remaining disruptions are also tracked. The start dates, finish dates and durations of each impact should be identified from the programme and verified using the as-planned programme, programme updates and other project records. This provides credence to disruption claims in which the impacts consumed significant time though the contract did not extent beyond the original completion date (i.e. they consumed available float).

#### Phase 2 - Proving quantum

The method proposed here for estimating the cost of disruption is based on window analysis principles. This involves the use of 'statused' and updated programmes to analyse the impacts of disruptions by breaking the project up into series of time periods or 'windows'. The disruption events identified as causing the productivity loss are considered in succession as they actually occurred and simulated on a cost/resource loaded CPM programme to determine their cost. The following gives detail description of the procedure involved.

## Step 3- Development of updated cost/resource loaded programmes

Project planning software with capability of aggregating total actual costs from resources incurred by activities should be used to develop an updated fully cost/resource loaded CPM model. This would represent the actual cost and time incurred in carrying out the contract at various stages. Development of the first model entails going through the following:

- a) The total project duration is divided into a number of time periods or 'windows' based on major changes in planning or major project milestones.
- b) The first 'window', defined as the period between the baseline programme and the first update, is updated to reflect the actual start and finish dates, durations and sequence of all project activities including delays and disruptions encountered.
- c) Labour and plant/equipment used by each of the activities within this window are identified. Based on resources utilized the analyst allocates the actual costs incurred to each activity including all disruptions encountered.
- d) To accurately capture the actual cost of disrupted activities, actual cost corresponding to disruption and no disruption components of such activities should be determined separately. This can be achieved by:
  - determining the scope of the impacted activity by reference to cost records and productivity data;
  - from this data, determine the likely measured mile period and the impacted period;
  - using the measured mile productivity, calculate the actual cost of the no disruption component of the activity and the impacted productivity values for the cost of the disrupted component;
  - where it is impossible to use measured mile approach, industry standards and publications/guidelines could be relied upon.
- e) With actual cost of all activities determined, the model is run to determine the 'actual cost of the project at the end of the first window' (TCPW). A copy of this model is saved and reserved for the development of a 'but for' model.

#### Step 4 - Development of a 'but-for' updated cost /resources programme

The 'but for' model represents the actual cost of the project at the end of a period but for the employer-caused disruptions. That of the first window is developed as follows:

- a) Using the cause/effect matrix developed, identify all compensable disruption events that occurred within the first window.
- b) These events are then removed from the model developed in step 3 above to derive a 'but for' model that gives the cost of the project at the end of the first window but for the disruption of the employer.
- c) The cost of compensable disruptions is thus given by the difference between the total cost as represented in the 'but for' programme and that prior to the removal as illustrated in fig 3.



Figure 3: Comparing cost loaded CPM models of a 'window'

#### Step 5- Quantifying disruption cost for the remaining windows

If the disruptions occurring in the first window are the only disruptions the project encountered, then the analysis ends, otherwise the analyst proceeds to examine subsequent windows as follows.

- a) The period of the second window is determined and updated as in the first window using the first update as the beginning time period for the second window.
- b) Repeat the procedures under steps 3 and 4 as described for the first window.
- c) Do the same for the remaining windows as appropriate.
- d) The total cost of disruption for which the contractor is to be compensated is given by the sum of all the disruption costs obtained for each of the windows.

#### Step 6 – Prepare claims report for settlement

Presenting the disruption claims results in an effective manner is vital to its smooth settlement through negotiation, arbitration, litigation or other forms of dispute resolution settings (Baki 1999). A claims report should thus be prepared to present the results clearly and concisely as possible. The report should focus on the main disruptions that were identified as impacting the project. Its content should include but not limited to:

- a narrative on the baseline programme, productivity data, cost records and other vital project records that were used with regards to their reasonableness and any correction that were made;
- a factual story on how each of the employer caused disruptions resulted in increased costs by tracing paths in the caused/effect matrix with support or evidence from the project records; and
- a discussion on how costs attributed to employer-caused disruptions were arrived at and how any inefficiencies due to the contractor's own mismanagement have been accounted for in each of the period analysed.

In addition, modern communication mediums like graphic charts, photographs and CPM models are available to help present the results appropriately. Effective use of

the graphics can simplify complicated issues and grabs the reader's attention or focus to the claimant's argument.

## Limitations and further studies

The proposed methodology has the potential of enhancing the settlement of disruption claims because it performs the analysis in a detailed, clear and equitable manner. In spite of this advantage, there are a number of potential limitations. Firstly, the method requires the use of software that has the facility to link CPM programmed activities with their actual cost and allows for the cost of the project to be determined at any given stage. Planning software packages with such capability are likely to be expensive for the affordability of smaller firms. Secondly, implementation of the method requires that actual cost be measured at activity level. This approach to job costing makes it inappropriate to apply the method for projects in which cost codes were not defined to represent actual activities that occurred on site at the appropriate level of detail. For instance, if cost codes were defined at work package levels, actual cost associated with activities of the work package may be lumped together making it difficult to attribute the cost effect of disruptions impact on the individual activities. Finally, the methodology relies very much on the availability of accurate progress and cost information of all activities, which may be lacking. However, this latter drawback equally applies to most existing methods for analysing disruption claims.

As a result of these possible limitations, further studies have been designed by the authors to ensure the usability and/or applicability of the methodology in practice. The subsequent stages of the research will focus on issues including:

- validation of the methodology using actual disruption claims to demonstrate its practicality;
- an investigation of the issues that are likely to impede its usability and acceptance. Addressing these issues could ensure the realization of the full potential of the methodology;
- investigating the application of IT for the automation of the methodology since the process involved is systematic in nature. This could speed up the analysis task and lead to savings in time.

# CONCLUSION

The construction industry is generally aware of the significant cost associated with disruptions and/or delays to contractor's progress. However, it is often recognized that proving these cost by contractors for their recovery in claims is an extremely difficult undertaking at its best. Whilst a number of methodologies are available for analysing disruptions claims, each method is found to be unsatisfactory from a number of different aspects. As a contribution to address this problem, this paper reports on an on-going research aimed at developing a framework for improving the analysis of disruption claims. Based on review of the literature, a systematic methodology is proposed which seeks to perform the analysis in fair and objective manner. The strengths of this methodology are:

• It performs the analysis in a detailed, clear and equitable manner. It is not biased in favour of either the employer or the contractor as all impacts caused by these parties are considered.

- It attempts to recreate the status of the project at the time of the disruptions and uses that to analyse their effects. This enables impacts to be directly related to changes experienced in working conditions.
- In addition to proving disruption, the methodology can be used to analyse delays at the same time. Existing methods lack such power because they tend to generally analyse delays and/or disruptions in isolation.
- The method can be used to determine the likely impacts of delay and/or disruption events in both time and money when negotiating a variation order. This is also useful in providing early warning indicators, which is necessary for the implementation of corrective actions in mitigating damages.

In spite of these advantages, there are a number of potential limitations, which should be addressed, to ensure that the proposed methodology realizes its full potential in practice. Subsequent stages of the research have therefore been earmarked to focus on addressing these limitations.

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