DEALING WITH DELAYS IN EVALUATING EXTENSIONS OF TIME

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Many construction claims and costly disputes are frequently linked to delays. The disputes usually relate to both (1) the identification of root causes and related responsibilities, and (2) the evaluation of net effects of such delays. An arsenal of different approaches has been deployed in evaluating EOT (Extension of Time) entitlements. This paper presents interim outcomes from an ongoing research project: (1) in comparing and classifying EOT evaluation techniques; and identifying principal strengths, weaknesses and 'best practices' in different scenarios; and (2) in formulating a basic structure and 'Level 1' modules of a proposed knowledge-based Decision Support System (DSS) that is envisaged to eventually assist either contracting party or their agents/consultants in evaluating EOT entitlements. These interim outcomes are based on findings from a preliminary questionnaire survey, a literature review and seven in-depth interviews with experienced practitioners in Hong Kong. The 'Level 1' DSS modules are designed to verify whether there is, in principle, a valid case for EOT (or not) triggered by any of the causes under clause 50 of the Hong Kong Government Conditions of Contract for Civil Engineering Works. The 'Level 2' DSS modules will deal with the quantification of any potential EOT. The interim outcomes, taken together with the present uncertainties and evident ambiguities in estimating EOT, confirm the need for developing the proposed DSS.

Keywords: claims, decision support system, delays, extension of time

INTRODUCTION

Construction projects often suffer from delays and consequential claims (Bordoli and Baldwin, 1998). This has prompted a proliferation of research in related areas, e.g. by Alkass *et al.* (1996), Scott (1997), Schumacher (1997), Wickwire and Ockman (1999), Pickavance (2000) and Adams (2001). Disputes often arise not only from disagreements on principles of entitlement for extension of time (EOT), but also over the evaluation methods used. The many different approaches to evaluating EOT often trigger further disputes, since clients / consultants and contractors may well use different techniques and reach divergent conclusions as found by Kumaraswamy and Yogeswaran (1999). These findings led to proposals for: (a) rationalization of existing evaluation approaches, (b) more explicit contract conditions that clearly convey the delay liability allocation policy and (c) corresponding decision support guidelines. This paper is based on a study that is comparing different approaches, and formulating a Decision Support System (DSS) based on the Hong Kong Government General Conditions of Contract for Civil Engineering Works 1999 Edition [hereinafter called GCC 1999]. The aim is to provide brief overviews of: (a) various techniques presently used to evaluate EOT, (b) a cross-section of views from industry practitioners on the related issues; and (c) the framework and a pilot module of the above DSS – that facilitate eligibility checks for EOT in Hong Kong civil engineering projects.

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OVERVIEW OF THE LITERATURE REVIEW AND INTERVIEWS

This research into the evaluation of EOT claims commenced with a study of international approaches, as well as Hong Kong specific practices and conditions of contract. A preliminary questionnaire survey in Hong Kong revealed the diversity of techniques used in evaluating EOT (Kumaraswamy and Yogeswaran, 1999).

A subsequent detailed study of the related international literature revealed that various techniques are used for evaluating EOT claims and even that a single technique may be known by different names. Much confusion and many disagreements have therefore resulted from different interpretations of the same delay scenario. A comparative review of the different EOT evaluation techniques in this study led to a rationalized classification that is summarized in Table 1. The main characteristics of each technique are conveyed in terms of the thrust assigned by their various proponents in Table 1 itself. In addition, a simplified comparison of the same techniques, highlighting strengths, weaknesses and relevant legal references led to the summary in Table 2.

Structured interviews with a cross-section of experts in Hong Kong were conducted for extracting experiential knowledge in evaluating EOT. Seven experts were chosen based on their reputation for being extremely knowledgeable and experienced in this domain. The main findings from these seven interviews are compared in Table 3.

Interviews with the experts focused mainly on the problems in assessing EOT claims. Amongst these, the most commonly cited is the inadequacy of records, both in terms of quality and quantity. Almost all related literature and views of experts interviewed highlight this deficiency. A related procurement-based deficiency was noted in the pressures to under-price tenders, thereby leaving inadequate resources for proper documentation. Other common problems in EOT evaluation include the choice of an appropriate technique, dealing with concurrent delays, ownership of float and failure to identify unambiguous linkages between causes and effects.

Although a few of the experts interviewed suggested some methods for quick first-order assessments of EOT claim entitlements, they were all cautious about the validity and accuracy of making conclusions based on such methods. The experts thus stressed the need for detailed and comprehensive evaluation of claims. A thorough evaluation of an EOT claim based on the individual merits of each case is therefore needed. This requires time and resources for realistic assessment. In this regard, the proposed DSS was seen to assist in reducing the time and cost resources required to assess a claim and to help to streamline the process. The proposed DSS also minimizes the risks of overlooking any aspects of the required evaluation process. It was therefore felt that a quicker and better assessment process could be facilitated.

OVERVIEW OF THE PROPOSED DSS

The diversity of potential approaches to evaluating EOT and the multiplicity of possible interpretations strengthened the need for a knowledge-based Decision Support System (DSS) that could capture, consolidate, rationalize and codify expert knowledge in a way that assists either contracting party to assess the merits of a case for EOT.

The general objective of the proposed knowledge-based DSS is to assist the user to evaluate EOT entitlements based on GCC 1999 in Hong Kong. Provision is made to expand the DSS in future to include more standard forms of contract e.g. Hong Kong Institute of Architects Form of Contract, Hong Kong Government Building Contract and FIDIC.

The DSS is designed to function in 2 levels viz.:

Level 1 – Test for Eligibility

Stage 1 - Common Checks for compliance

Stage 2 - Specific Checks for 'Validity in Principle' against a particular permissible cause of delay

Level 2 – Provide Quantification guidelines for eligible entitlements

The structure of Level 1 of the proposed Knowledge Based Decision Support System (DSS) was formulated as in Figure 1, based on the knowledge gathered from both documented and experiential sources and the views of the experts interviewed. This was developed in stages by presenting the initial structure to experts and refining it on the basis of their feedback

'Common Checks' at the Level 1 are primarily to check for compliance with any 'delay notification requirements' of the Contract (which may be superposed by the Special Conditions as in some Hong Kong projects). If these checks are satisfied, the user will be directed to the second stage, which specifically checks for the 'validity in principle' of any potential EOT entitlement under the various provisions of the EOT and related clauses of the above Conditions of Contract. Specific provisions of these Conditions of Contract, are supplemented by experiential knowledge 'mined' from domain experts and relevant, literature, in drafting and sequencing questions in flow chart formats. Appropriate clusters of questions are developed to reflect each individual sub clause of the EOT provisions. The idea is to give the user advice on whether any of the required criteria are met in qualifying for EOT both procedurally and in principle. A sample flow chart based on one of the permissible causes in GCC 1999 - Inclement Weather - is shown in Figure 2. Similar flowcharts have been developed for 10 other permissible causes under Clause 50 (1) (b) of GCC 1999. Although inclement weather is not usually limited to heavy rainfall but may also include extreme heat, cold or wind, the possibilities of such conditions (typhoons being dealt with under a separate clause) are very rare in Hong Kong. Only heavy rain is thus considered under the 'Inclement Weather' cause.

Level 2 of the DSS is intended to help quantify the EOT entitlements, which have qualified for EOT in terms of procedural compliance and 'validity in principle'. Development of this part of the prototype has just commenced. The idea is to assist users to quantify EOT entitlements by (a) advising on suitable evaluation techniques (i.e. appropriate to the given project and delay scenarios) as derived from the knowledge mined from experts and relevant documents; and (b) advising on approaches to dealing with special problems. These include the types of technique to be chosen based on the information available and other considerations of the impacts and implications of floats, concurrent delays, parallel critical paths and delay mitigation requirements. This will also be structured on the basis of appropriately sequenced clusters of questions in a flow chart format. The user would then be guided to evaluate and quantify any potential EOT by using a recommended technique that

Table 1: A classification ot techniques used in evaluating Extention of Time

Primary Evaluation Techniques	Pickavance (2000)	Bordoli and Baldwin (1996)	Alkass and Harris (1996)	Adams (2001)
As-Planned Bar Chart V As-Built Bar Chart	Basis: Compares original contract period with actual one. Remarks: (i) Acceptable if the activities of Delay are on Critical Path (CP). (ii) Rarely used.	Basis: Comparison of As-planned versus As-built bar chart		
Collapsing Technique	Basis: Excuasble and non excuasble delays are added to the As Planned Programme (APP) to form an As Built Programme (ABP). Delays are then extracted from ABP and displayed at the end of APP Remarks: Suitable for slightly more complex cases than above.			
Global Impact			Basis: Delays are plotted on a summary bar chart. Total Delay = sum of individual delays	
Net Impact			Basis: Only the net effect of all delays including concurrent delays are plotted on a bar chart based on the as built schedule and compared with the as planned	
Adjusted As Built Critical Path Method		Basis: All Delays are added to the as-planned programme. Impact of all these dealys are then assessed and apportioned	Basis: Excusable and non-excusable delaying events are depicted as activities and linked to specific work activities. CP is identified twice, once in the as-planned and the other at the end of the project.	
As Planned Impacted Programme (APIP)	Basis: Owner caused delays are added to the APP Remarks : Suitable for (i) Smaller contracts or (ii) For larger contracts where the impacts have occurred over limited periods, or (iii) Where the APP has been affected by a limited number of delays.			Basis: Delays are added (impacted) to the original plan Remarks: (i) Popular (ii) Simple (iii)#Works well with simple logic driven sequence of activities (iv)#Works well if a given order of activities is followed (v)#Static type
AS BUILT BUT-FOR (ABBF)	Basis: Owner caused delays are subtracted from the ABP. Remarks: Popular with Developers and Contractors	Basis: Excusable delays are subtracted from as-built network.	Basis: Delays for which one party is responsible are shown on the As-Built and compared with the As-Planned	Basis: Excusable delays are subtracted from the ABP Remarks : (i)#Based on actual build times - leads to a convincing argument (ii)#Simple to present and understand (iii)#Highlight delays on the longest path and not necessarily critical to completion
WINDOW ANALYSIS	Basis: CPM is updated on a regular intervals using any method (e.g. ABBF, APIP etc). Remarks: Suitable for all projects.	Basis: As planned net-work is updated at regular intervals and the impact of delays is analysed within each window		Basis: This technique uses several programmes, taken within regular 'time slices' or 'windows' Remarks: It is possible to check whether delay(s) impacted upon the critical path in a particular 'window'
SNAPSHOT ANALYSIS	Basis: A technique designed to identify and quantify programme impacts contemporaneously through an analysis of the status of the project at the time critical events occurred. Remarks: Works well on smaller projects. Will involve vast amount of data and thus have limitations for complex projects			Basis: Examines the delay effects during different stages of the project. The intention is to get a 'stop action picture'. Remarks: Also known as Time Impact Analysis

Table 2: Strengths, weaknesses and cross references of various EOT evaluation techniques

Primary Evaluation Techniques	Other Names /Similar Techniques	Strengths	Weakness	Case Law
As Planned Bar chart V As Built Bar chart	Total Time Claim (USA)	Easy to prepare.	A non Critical Path Method(CPM). Does not consider consequential and concurrent delays.	Titan Pacific Construction Corp. V The United States (1989) (Pickavance, 2000)
Collapsing Technique		Shows excusable, non-excuable and compensable delays of a project.	As above.	
Global Impact		Relatively easy to prepare	Non CPM method.	
Adjusted As Built CPM		All delaying events (excusable and non-excusable) are included.	Difficult to apportion the excusable and non-excusable impact on the overall delay.	Haney v United States (1982), (Wickwire, 2000)
As Planned Impacted Programme (APIP)	(i) What If (ii) As-Planned expanded	(i) Simple to understand (ii) Works well with simple logic driven sequence of activities (iii) If there is a high level of certainty that a given order of activities will be followed (iv) Only excusable delays are included.	(i) Static analysis (ii) The contractor rarely keeps to his initial plan (iii) Non-excusable delays are ignored.	Gulf Contracting Inc.(1989), Ealahan Electric Co. (1990) (Pickavance, 2000)
As Built BUT-FOR (ABBF)	(i) As Built Subtracting Impacts (ii) Collapsed As Built CPM	i) Based on actual build times – leads to a convincing argument ii) Simple to present and understand	Highlights delays which are on the longest path and not necessarily which may have been critical to completion	Cannon Construction Corporation-(1972) (Pickavance, 2000)
Window Analysis	(i) Time Slice (ii)#Contemporaneous Period Analysis	Change of critical path at various time slices are taken into account instead of one single Critical Path for the whole project.	More complex than the other methods used.	
Snapshot Analysis	Time Impact	Works well on smaller projects. Can show the true effect of an event.	This will involve vast amounts of data and thus have limitations for larger and complex projects with hundreds of excusable and non excusable delays.	

Table 3: Summary of interviews with experts (1 of 2)

Questions/ Discussions	Expert 1 : Consultant A	Expert 2 : Client A	Expert 3: Consultant B
Evaluation methods: a) In Principle,	Identify reasons and check contract clauses	CPM (Critical Path Method)	(i) Check programme Vs. Progress.(ii) Check whether method statement and resource allocations are suitable for the Project
b) In quantifying	As Built CPM Vs. Original	As Built CPM Vs. Original	as above.
Other methods (rule of thumb) for evaluating EOT	No	Snapshot	No
Criteria for selection of Evaluation method	As Built CPM gives more accurate answers	(i) After completion - As Built CPM (ii) During construction-Snapshot.	Programme Vs. Progress
Common Problems in assessing EOT Claims	(i) Parallel Critical Paths; (ii) Concurrent delays; (iii) Culpable delays.	(i) Poor submission, (ii) Lack of information, (iii) Late submission etc.	(i) Badly planned project; (ii) Inappropriate /un-achievable method statement
Problems in assessing claims related with Civil Contracts	(i) Parallel Critical Paths; (ii) Concurrent delays; (iii) Culpable delays.	(i) Multiple Critical Paths; (ii) Concurrent Delays; (iii) Excusable and Culpable Delay (iv) Mitigation effect.	(i) Unforeseen ground conditions.
As above: Building Contracts	As above	As above	(i) Nominated /Specialist contractors-problem of control
Any Specific problems in assessing claims related with any Standard Forms	_	HK Government forms no EOT for unforeseen ground conditions. FIDIC more prone to argument.	-
Suggested solutions to resolve these problems	Standard forms of notification and record requirement shall be incorporated in the Contract	The records have to be agreed with the aid of computers between Contractor and Engineer and updated as the Works progresses	Change of procurement system. e.g. incorporate Partnering between Employer and Contractor.
What particular shortcomings in present practice or available evaluation methods should be addressed by the present study	Theoretical EOT claims without considering dependencies of activities or critical paths should be avoided.	To recommend a simple method for EOT evaluation. Encourage assessment of delays as the work progresses.	Plan well in the beginning. Highlight risks. Work to plan and be pro-active in managing problem. Have a check list to monitor changes and record them.
Any suggestions to consider in the proposed DSS for assessment.	Computer software sometimes ignore dependencies of activities resulting in unrealistic and 'theoretical' EOT.	Logic introduced into the DSS should be practical and follow the industry practice	As mentioned in the above answers.

List of main Abbreviations used in the paper:

ABBF	As Built But For
ABP	As Built Programme
APIP	As Planned Impacted Programme
APP	As Planned Programme
CP	Critical Path
CPM	Critical Path Method
DSS	Decision Support System
EOT	Extension of Time
FIDIC	Fédération Internationale Des Ingénieurs-Conseils - Conditions of Contract for works of Civil Engineering construction - 4th Edition 1987
GCC 1999	Hong Kong Government General Conditions of Contract for Civil Engineering Works 1999 Edition

Table 3. Summary of interviews with experts (2 of 2)

Questions/ Discussions	Expert 4: Consultant C	Expert 5 : Client B	Expert 6: Consultant D	Expert 7: Contractor A
Evaluation methods: a) In Principle,	(i) Complex and logic driven jobs-Window Analysis (ii) Resource driven jobs-check quantum of work planned vs. quantum of work done. (iii) As built collapsed CPM for quick analysis	Use " Damage Approach" to check validity in principle	Comparison of As Built with As Planned Programme. Methods of valuation depend on the Quality and the Amount of information available.	Check for causation of the damage.
b) In quantifying	as above.	Use one of the methods such as Global Impact, As Built CPM, Window Analysis etc.	As Planned Vs. As Built and see the difference.	Use one of the CPM techniques. Ongoing use regular updates such as Window Analysis and discuss with the Client.
Other methods (rule of thumb) for evaluating EOT	(i) No. (ii) Always try logical and reasonable method		No	Measured Mile technique
Criteria for selection of Evaluation method	Logic driven – Programme Vs. Progress, CPM Analysis. Resource driven – Quantum Based method.	Choose a method which gives the least amount of EOT and compromise with the Contractor.	Selection of a method depends on the quality and quantity of the information available.	Depends on the situation. Use one of the CPM techniques. Ongoing use regular updates such as Window.
Common Problems in assessing EOT Claims	(i) Contractors rarely update programmes; (ii) Rarely use network techniques (iii) Not enough planning of works (iv) Poor records	Evidence.	(i) Concurrent delays (ii) Lack of records (iii) Exaggeration of claims (iv) No link between cause and effect	(i) Concurrent Delays, (ii) Float Ownership, (iii) Exaggeration of claims. (iv) Using unsuitable techniques
Problems in assessing claims related with Civil Contracts?	as above.	(i) Interface with the utilities, public depts. etc. introduce too many variables. Thus, difficult to assess.	(i) Quality of the submission (lack of properly detailed claim); (ii) Lack of records.	(i) Failure to notify delay on time, (ii) Lack of records.
Ditto. Building Contracts?	Ditto.	Not involved	Ditto.	Not involved
Any Specific problems in assessing claims related with any Standard Forms	As per Works Bureau Technical Circular 28/99, the Engineer shall seek permission of the Employer in granting EOT, under GCC 1999	Under GCC 1999, apportionment of risk is too fair to the Contractor.	-	KCRC/MTRC contracts are based on approved works programme (WP). For re-sequencing the WP due to a variation, the change needs to be established
Suggested solutions to resolve these problems	(i) Proper procedure (ii) Check records regularly and take corrective action	Select Contractors not just based on price, but also ability, past record, equipped well to manage the job, quality staff.	Each individual case has to be studied on its own merits to identify proper solutions.	Early subletting helps tie up the sub contractors' programme with master programme (MP) from Day 1 of the project thus easy to get records from subcontractor.
What particular shortcomings in present practice or available evaluation methods should be addressed by the present study	(i) Lack of knowledge of Professionals involved in preparation / assessment of claims; (ii) Contract-ors need to update programmes regularly & get EOT in the interim stage rather than waiting till the end of the job.	Standard forms need to specify time frame for resolution of claims. If not resolved within that time, they lead to disputes needing resolution.	Educate the contractors to keep good records, make quality submissions	The tender period is generally too short. This leads to the tenderer trying to claim for basically everything to cover-up errors made in tender price.
Any suggestions to consider in the proposed DSS for assessment.	DSS to give option to the user to choose from Window Analysis for Logic Driven and As Built CPM for Resource Driven Projects.	Need a handy software to evaluate EOT.	---	-

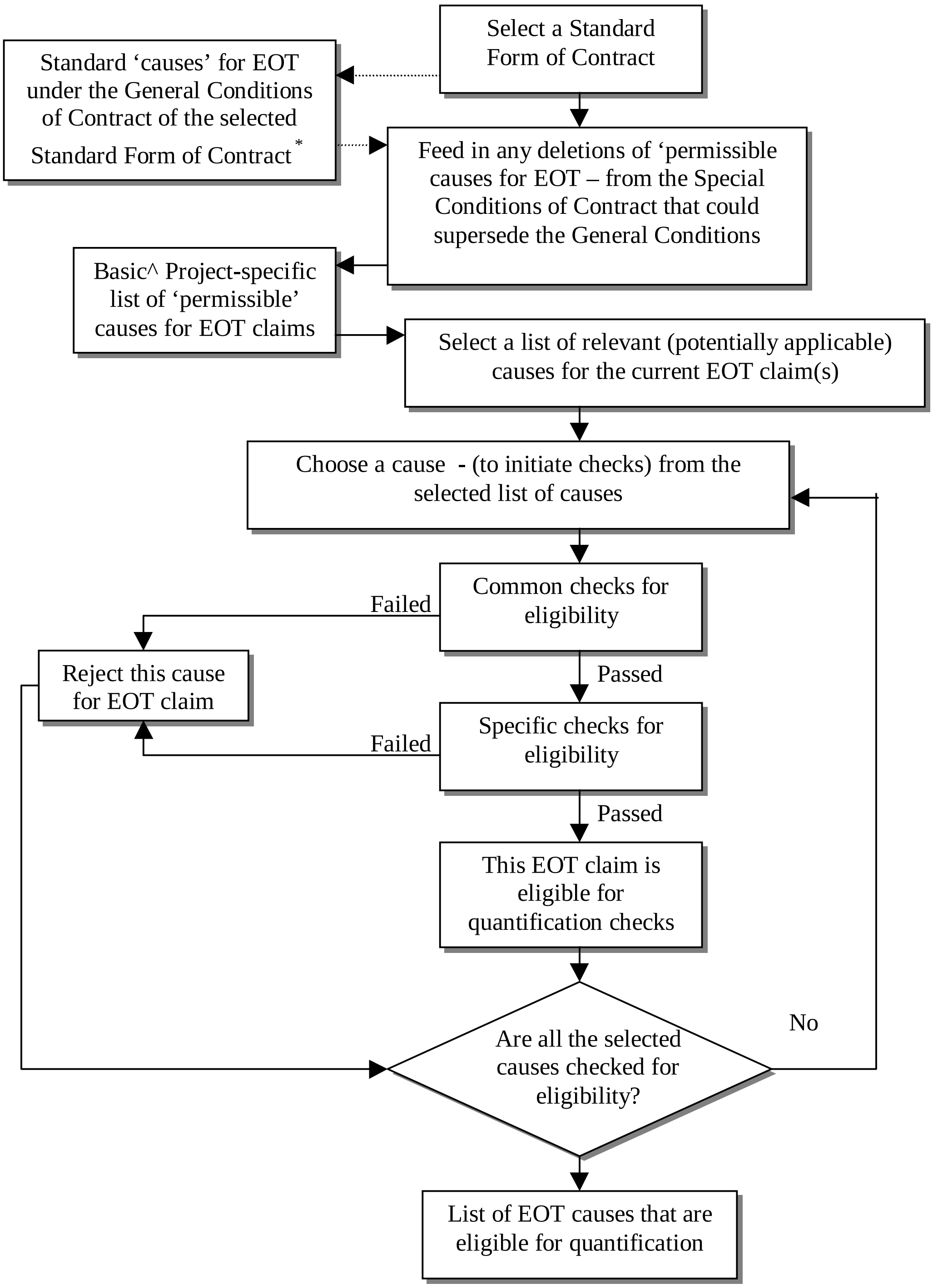

Figure 1. Structure of the knowledge-based Decision Support System (DSS) for checking the overall eligibility of Extension of Time Claims

Note:

- - - Feed from the DSS knowledge base of lists of standard 'causes' for EOT

* e.g. standard 'causes for EOT as per the Government of Hong Kong Standard Form of Contract for Civil Engineering Works (1999) are (1) inclement weather; (2) typhoon 8 or above; (3) black rainstorm warning; (4) engineer's instruction under Clause 5; (5) variation order under Clause 60; (6) increase in quantity not due to a variation; (7) late possession; (8) disturbance to progress due to employer/ engineer or specialist contractor; (9) suspension of works by the engineer; (10) delay by utility companies; (11) delay by NSC; (12) any other special circumstances

^ Excluding any additions from Special Conditions – which must be dealt with separately.

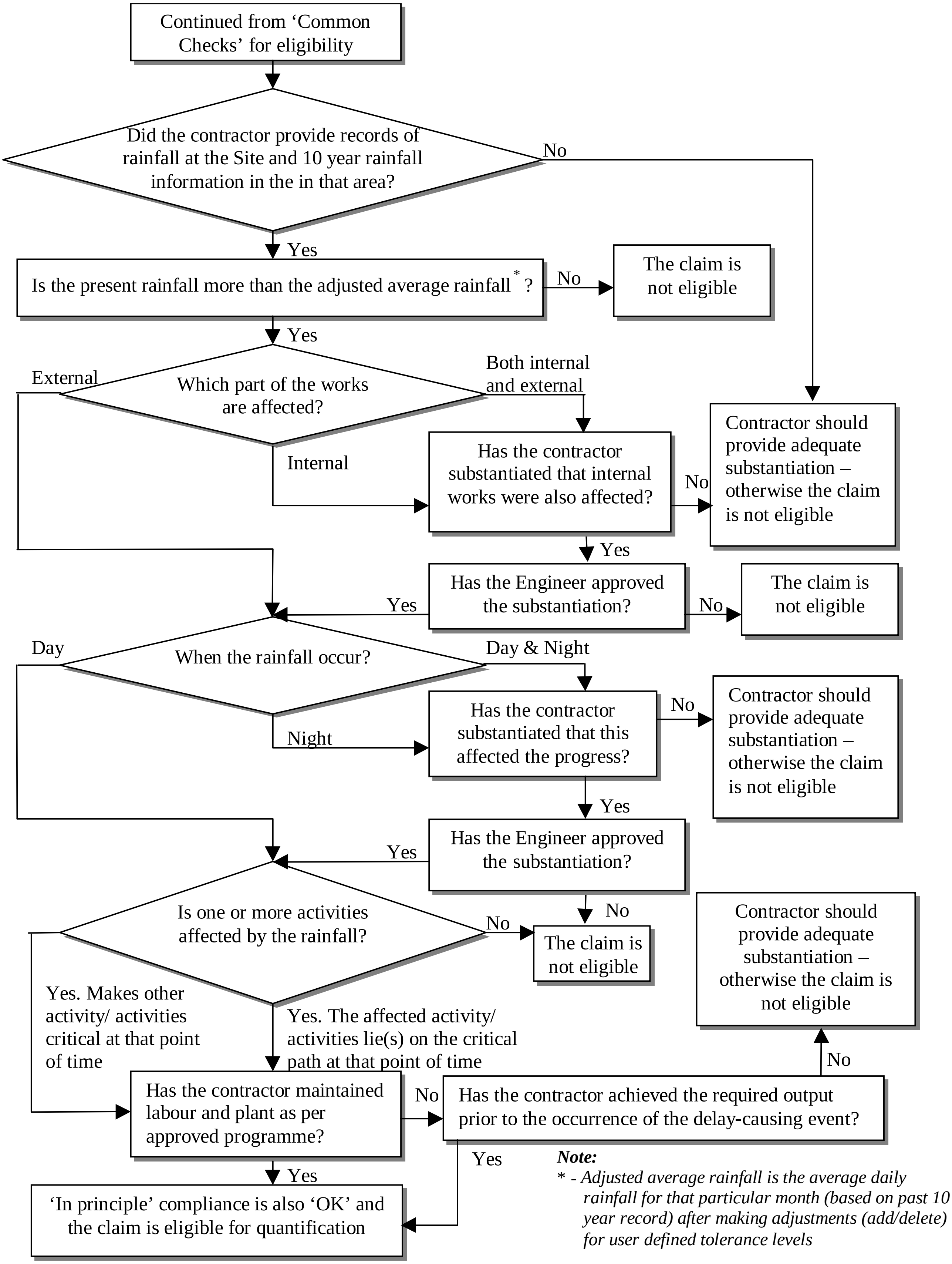

Figure 2. Sample framework of 'Specific' checks for eligibility against a particular permissible cause – 'Inclement Weather'

will suit that particular scenario. Guidelines and checklists will help provide general advice. The model presented by Bordoli and Baldwin (1996) is considered useful to provide a basis for developing a methodology for this next level of the DSS.

CONCLUSIONS

The survey, interviews and literature revealed marked divergences in EOT evaluation approaches. This was also seen to lead to a series of complex claims and disputes. The proposed knowledge based DSS attempts to overcome some of these problems. The presently wide gaps in EOT assessments should narrow down considerably if based on objective approaches that will be recommended through the proposed knowledge-based system. A further convergence is also envisaged with intelligent linking to appropriate project management software and related contract management systems. Meanwhile, the proposed Level 1 of this DSS (for 'eligibility checking' of time extension claims) is itself, expected to generate cost and time savings for clients and contractors, and their agents/consultants by minimizing potential disputes.

The next stage of this research exercise envisages refinement of the prototype Level 1 modules and a development of the proposed structure of Level 2 of the DSS. This will then be presented to a set of experts (probably from a target group comprising the same seven experts interviewed, together with about three others who will be invited) at a workshop or in a focus group format, to elicit their feedback for improvements. It may be noted that two experts have already commented upon and then endorsed the improved Level 1 modules.

However, the DSS will only provide knowledge based assistance in EOT evaluation. The diversity of contractual provisions and the complexity of delay generating patterns (and related events, actions and counter-actions) still require users to mobilize adequate relevant records, previous programme updates (at relevant points of time) and a sound knowledge of the factual cause-effect scenarios.

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REFERENCES

Adams S. (2001) Modern delay analysis techniques, *Proceedings of 'Delays, Damages and Extensions of Time Seminar'*, 21 Feb. 2001, James R. Knowles (HK) Ltd., 2/1-2/33.

Alkass S. Mazerolle M. and Harris F. (1996) Construction delay analysis techniques. *Construction Management and Economics*, **14**, 375-394.

Bordoli DW and Baldwin A N., (1998) A methodology for assessing construction project delays. *Construction Management and Economics*,**16**, 327-337

Kaka A.P. and Aouad G. (1995) Decision support system for contractor's financial strategies. *Proceedings of Sixth International Conference on Computing in Civil and Building Engineering*, Berlin, Germany, 1517-1524.

Kumaraswamy M.M. and Yogeswaran K. (1999) Evaluating time extension entitlements. *Construction Law Journal*, **15**(6), 437-445.

Pickavance K. (2000) *Delay and disruption in construction contracts*. 2nd Edition, LLP Reference Publishing, London.

Scott S. (1997) Delay claims in UK contracts. *Journal of Construction Engineering and Management*, **123**(3), 238-244.

Schumacher L. (1997) Defusing delay claims. *Civil Engineering*, ASCE, 60-62.

Wickwire, J.M. and Ockman, S. (1999) Use of critical path method on contract claims – 2000, *The Construction Lawyer*, October 12-21