Application of Engineering Management Information on Construction Disputes and Claims

Min-Yuan Cheng[1]   Chi-En Chang[2]

Department of Construction Engineering, National Taiwan University of Science and
Technology#43,Sec.4, Keelung Rd., Taipei, 106,Taiwan, R.O.C
myc@hp.ct.ntust.edu.tw

ABSTRACT: The high risk, uncertainty and complicated interface for division of work in the construction industry have resulted in endless engineering dispute issues. Submitting claims during the performance of construction contracts can be money wasting and time-consuming process. This paper summarizes dispute issues occur often on construction site, clarifies what responsibility each party should bear, identifies the compensable claim items in each dispute issue and lists suggestion estimation formulas for each claim item for quantifying. By using eEPC diagram to represent management process in General Construction Company (GC), the paper pioneers in discussing the proof evidence required by each construction claim and mapping among daily management records. According to the mapping, construction managers can efficiently clear up daily management records they need for testifying truth and calculating compensation amount. Finally, the study adopts object-oriented technique to develop a Construction Claim Decision Making System (CCDMS) for implementation. CCDMS displays entitlement and claims quantum for assisting claim presentation.

KEYWORDS: Construction Disputes and Claims, Daily Records, Construction Claim Decision Making System (CCDMS)

1. INTRODUCTION

Since construction itself is a complicated, high risk and uncertain task, it is hard for constructors to identify their claim item and compensation amount, when a construction dispute arises unexpectedly. If the compensation items and amount could be known as early as possible to serve as reference for decision-making whether a claim is to be raised or not, the constructors would probably save their loss in today's vacillation business environment.

This paper summarizes dispute issues often occur in construction contracts, making clear what responsibility each party should bear, identifying the claim items for each dispute and listing suggested quantitative formulas for each claim item to assist project manager in construction claim process. In this way, constructors can not only detect claim item "timely" and "accurately", yet still effectively make a decision whether to raise a claim or not.

In this research intends to collect and clarify correlation between claim item and corresponding evidence records in management activity. When a construction claim arises, constructors are able to submit correlated documentary evidence from management process. This can prevent constructor from losing his due rights because of shortage or impropriety in the evidence records.

In this research, a Construction Claim Decision Making System (CCDMS) is developed to automate the claim process and calculate the claim quantum amount. It sets a step-by-step procedure for collect and clarify dispute causes occurred in construction contract and find out the items that can be claimed for compensation according to a variety of causes.

Furthermore, it arranges relevant documentary evidence required by all kinds of claim items and provides the pilot calculation function for the compensation amount so that the constructor can correctly identify the claim item, collect hard facts and estimate time extension amount and cost recovery for compensation. Provided to the constructor, this system serves as suitable analysis and facilitating presentation during the course of a claim for compensation. This system is developed by object-oriented (OO) technique, which can help extensibility and maintainability of the system be fulfilled.

2. ESTABLISH CLAIM PROCEDURE MODEL

Some construction claims of excellent merit are lost solely due to failure of identifying them (Easton 1989). Hence, a step-by-step procedure will discuss dispute issues often arise in construction project, correspondence between dispute issues and claim item, and summary of proper quantitative formula for each claim item.
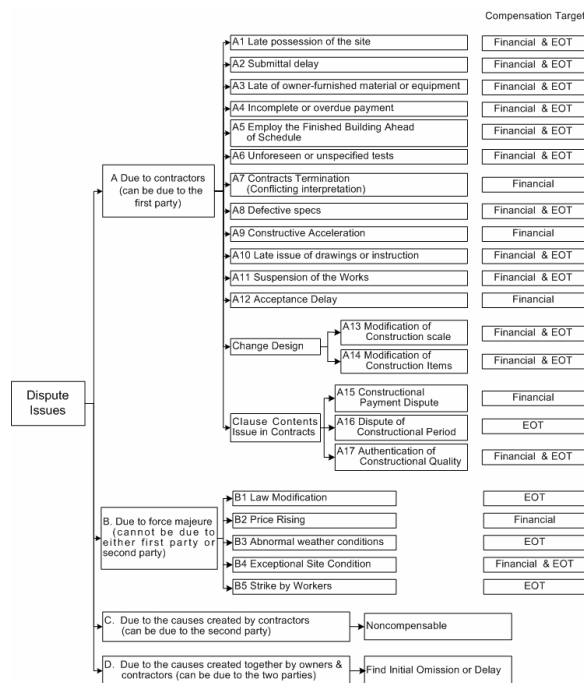
Summarization of Dispute Issues

Construction claims originate from a variety of causes both directly and indirectly (Stokes 1977). A number of major disputes can be largely traced to four basic types by responsibility. 1. Due to contractors (can be due to the first party), 2. Due to force majeure (cannot be due to either of the two parties), 3. Due to the causes created by owners (can be due to the second party) and 4. Due to the causes created together by owners and contractors (can be

due to both the two parties).

According to the above four types of liability. *Figure 1* presents dispute issues usually occur in construction work. There are 17(A1~A17) issues belong to the first party and 5 (B1~B5) issues which don't belong to the first party or the second party. Moreover, two compensation targets, financial claim or claim for extension of time (EOT) in each dispute issue is listed in the figure.

Take the A1 "Cannot Provide Area on Schedule" as an example, if this dispute issue arises, constructors can notify to owners to compensate for both financial claims and those for EOT. The purpose of making clear the Compensation Target is to make constructors determine efficiently which kind of claim should be submitted and provide right direction for further claim examination and documentation.

Figure 1 Classification of Dispute Issues & Compensation Target

Correspondence between Claim Item & Dispute Issues

In general conditions of the construction contract. The claim item generally proposed by the constructor fall under two major categories: cost and time. In the first category, the constructor asks for reimbursement to cover the following item C1~C20 shown in the *Table 1*. In the second category, the constructor requests a modification of contract delivery dates and milestones to offset the delays either caused by abnormal weather conditions or strikes (C21, C22) or not. If the require delay is not yet obvious, the common quantification analysis methods of CPM Techniques, Productivity-Loss estimation methods and Simulation techniques are usually used for delay estimation. The outcome of analysis is claim item of time extension (C23). (Jervis and Levin 1988) (AbouRizk and Dozzi 1993)

Table 1 Table of Possible Claim Item

No.	Claim Items
C1	Increased labor costs due to the quantity increasing (direct)
C2	Increased labor costs due to productivity-loss (indirect)
C3	Increased labor costs due to delay (direct)
C4	Increased material cost due to quantity increase
C5	Increased material cost due to unit price raising
C6	Increased cost due to added new portion of the work
C7	Increased cost due to newly added subcontract
C8	Increased overhead cost of equipment lease fee
C9	Increased overhead cost of equipment operation fee
C10	Increased overhead cost of site infrastructure
C11	Increased home-office overhead
C12	Increased insurance premium
C13	Interest of overdraft loans
C14	Profit lost during delay period
C15	Expenses of employing consultants
C16	Traffic control and security measures
C17	Labor Safety and Hygiene Fee
C18	Interest of Bond/Reserved Fund
C19	Construction cost of the item
C20	Renewal expense for building damaging, finished
C21	Delaying time cause by abnormal weather conditions
C22	Delaying time cause by strike of worker
C23	Extension of contract time

Note that the two categories are very much interrelated. For instance, any delays are apt to cause an increase in all cost items, and any productivity drop causes an increase in the duration required to finish the work. Hence, the contractor may claim any combination of the above factors, or possibly all of them. Therefore, study first divided compensation items into two classes: (1). Claim items which should be listed, (2). Claim items which are listed according to instances. To take the claim item related to dispute issue item about A1"Late possession of the site" as an example, its claim items that should be listed like C11 Increased home-office overhead, C13 Interest of overdraft loans, C14 Inflation cost during delay period and C23 extension of time. In addition, the claim items, which are listed according to instances, contain C8 equipment lease fee, C12 increased insurance premium, C15 expenses of employing consultants, C16 traffic control and security measures and C17 labor safety and hygiene fee. According to the above method of classification, each dispute issue is arranged and listed to correspond to every claim item as shown in *Table 2*.

Selection of Quantitative Formulas

If the analysis shows that constructors have valid grounds for a claim, the engineer now has the task of quantifying the amount of compensation (in term of cost and time) that the contractor is entitled to.

Table 2 Relation between Claim Items and Dispute Issues (Simplified)

		Code of Claim Items																						
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23
Code Of Dispute Issues	A1								○			◎	○	◎	◎	○	○	○						◎
	A2								○			◎	○	◎	◎	○	○	○						◎
	….	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
	B1			◎								◎	○	◎	◎			○						◎
	B2			◎		◎						◎			◎									
	….	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…

◎ ： Claim items that should be listed,
○ ： Claim items that should be listed according to the actual circumstances

Table 3 Construction Claim Item and Evaluation Formula (Simplify)

No.	Claim Item	Evaluation
C1	Increased labor costs due to the quantity increasing (direct)	1. ｛[(Labor Cost under Quantity increase Condition－Labor Cost at Normal Condition)×(1+ Administrative Expenses)]｝×(1+Profit) 2.Real Expense
…..	…………………..	…………………….
C23	Extension of contract time	1. Date of Delay

To achieve this proposal, the engineer has to resort to the very same quantification methods proposed earlier for use by contractor to substantiate the claim. *Table 3* is the outcome of selected common estimated formulas to calculate compensation amount about cost recovery. In *Table 3*, C23"Extension of contract time", delay analysis has a lot of complex quantification methods, for instance, CPM techniques, Productivity-Loss analysis and Simulation techniques etc. Contractor can select an advantageous method to demonstrate legitimate of the claim. Therefore, estimation of EOT is not included in this research. C1~C19 are the items about financial claim. There is no clear-cut method to quantify the cost damage in each item. Hence, based on the literature and domestic construction claim case review. This study lists most common acceptance estimation formulas to calculate the amount of each compensation item. As a result, *Table 3* serves as reference for constructor to quickly achieve the estimation formulas and provides a base for system to calculate the amount of compensation.

3. VERIFY EVIDENCE FOR CLAIMS

The contents of this stage will be divided into three parts for discussion. Firstly, by virtue of the representation of the GC's management process to make clear activity in each process and the records presented by various kinds of activities. Secondly, arrangement records can be used for calculating the damage or evidences for seeking compensation. Finally, with the help of case documents and interviews with practitioners, study confirms the correlation between the claim item and supporting records. Consequently, The main framework of this concept is demonstrated in *Figure 2*. This concept is based on the claim items occurred by the dispute issue, constructors can easily, promptly and correctly know what records are required for each compensation claim items and which activity creates these forms in the management process of GC. Therefore, this will improve the efficiency and effectiveness for claim documentation; daily records also serve as reminders to engineers to avoid claims.
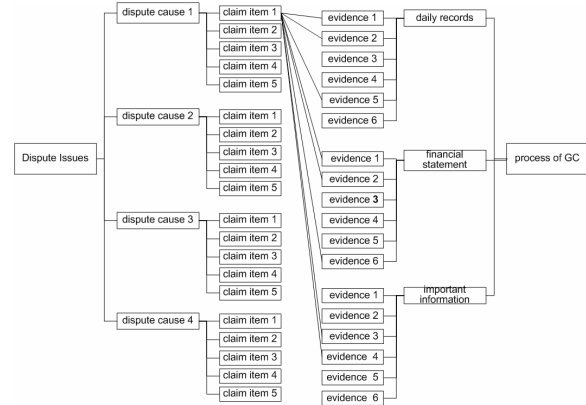

**Figure 2 Relations Between Claim Items and Evidence in Process**

Representation of Constructors Operation Process

Study has investigated the existing operation process of General Construction Company, established the management process of GC with the technique of process representation, and restarted the process with the help of the Event Guide Program Chain (eEPC) diagram in Architecture of Integrated Information Systems (ARIS) tool (Scheer 1994). The output, export documents requirement for every function activity, the department and personnel participating in execution of the flow are clearly described.

In this research, the Value-added Chain Diagram (VAD) is applied to divide the work and service operation of GC into 12 key management process (shown in *Figure 3*), clarifying each operation process of constructors, this study unfolds the detailed operation approach of every operation flow by means of the eEPC diagram. It uses the procurement/subcontracting process as an example for explanation (shown in *Figure 4*).
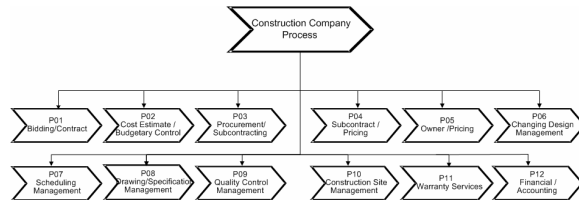
Figure 3 GC's main process by VAD diagram
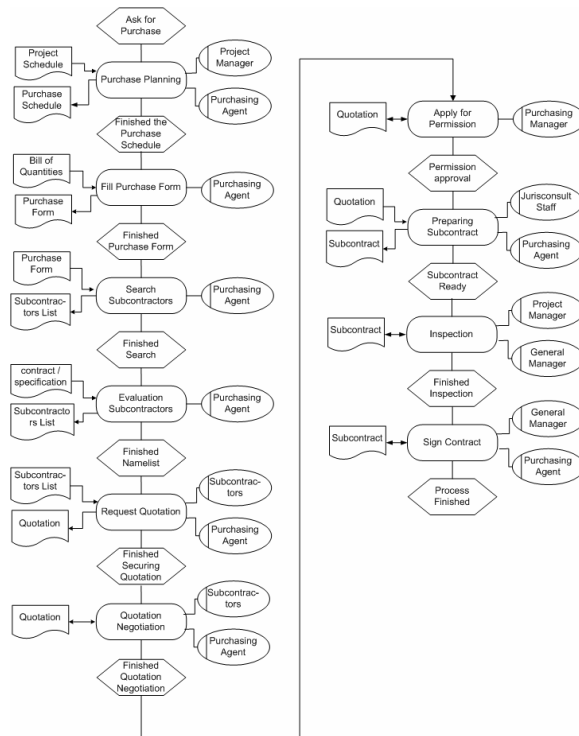
Figure 4   procurement/subcontracting process eEPC diagram

Arrangement Business Records for Evidence

After representation of GC's 12 processes using eEPC diagram, the study can clearly identify every input/output business records in each activity. Take the P03 procurement/ subcontracting process as an example, every business records export in each activity in procurement/subcontracting process are listed in *Table 4*. Each export document gives an identify number, for example, P03 means number 3 management process of procurement/ subcontracting, the rest two letters refer to activity in the process.

Based on this sequence for analyzing 12 processes in GC, study lists 120 records in management process which assign the start number of "P", 16 financial statements which assign the start

number of "AC" and 5 important report assign the start number of "I."

Therefore, according to the precedent of domestic construction claim cases (Su 1997). Study has selected 28 daily records (listed in *Table 5*) from 141 documents represented in previous stage, which can be proved evidence used in claim analysis and documentation.

Table 4 Export documents in P03 procurement/subcontracting process (Simplify)

P03 procurement/subcontracting process		
No.	Activity	Export documents
P0301	Purchase Planning	Purchase Schedule
P0302	Fill Purchase Form	Purchase Form
……	……	……
P0310	Sign Contract	Subcontract

Relation Between Claim Item and Evidences

Documents are essential parts of effecting a successful resolution and disposition of claims. Each claim item needs its own daily records for claim analysis and documentation. Study has divided the evidences into two groups. Firstly, documents to prove the truth, which is the evidence to prove the claim event actually occur or exist. In those documents, claim representatives can identify conflicts between project and contract; it can recognize the dispute arising time, description about claim item. Secondly, the documents can provide the time and cost elements to assist in calculating loss. Base on the claim item listed in *Table 1* and the evidences selected in *Table 5*. *Table 6* is the result of correspondent between claim item and evidences, which is accumulated in this study. For instances, if claim item C1 "Increased labor costs due to the quantity increasing (direct)" is needed for compensation. Claim representative can easily refer table 6 to identify records needed for submitting this claim item, it needs to collect P0103 Project correspondence, P0604 Written variation order, P1002 Progress photo with commentary, P1003 Minute of site meeting, P1008 Daily work & progress reports for truth proven, and P0203 Bill of quantities document, P0305 Quotations, P1005 Site diaries, AC1 Crew hours summary/Payroll records to calculating compensation amount.

Table 5. Evidences for claim documentation

No.	Support document
P0103	Project correspondence
P0105	Condition of contract & specification
P0203	Bill of quantities document
P0208	Productivity & cost reports
P0305	Quotations
P0310	Subcontract & specification
P0407	Payment application & certificates
P0503	Delivery records
P0604	Written variation order
P0705	Construction schedules

P0802	Drawing register
P0903	Records of inspections & directions
P0907	Register of Submittals
P0909	Accident & site safety reports
P1002	Progress photo with commentary
P1003	Minute of site meeting
P1005	Site diaries
P1007	Records of delay & disturbance
P1008	Daily work & progress reports
AC1	Crew hours summary/Payroll records
AC2	Payment receipts
AC3	Journals/ledgers
AC4	Interest expenses (bond, fund, etc)
AC5	Interest loss (delay parments, etc)
AC6	Field office expense docket
I1	Important news (strike, price-hike, etc.)
I2	Economic policy report
I3	Ten years domestic weather records

Table 6 Relation between claim item and evidences (Simplify)

	C1	C2	C3	C4	C5	C6	C7	C8	…	C22	C23
P0103	◎			◎		◎			…	◎	◎
P0105				◎					…		
P0203	○	○	◎	○	◎	○		○	…		
P0208		○			○				…	◎	
P0305						○	○	○	…		
P0310							◎		…		
P0407					◎			○	…		
P0503				◎	◎				…		
P0604	◎			◎		◎			…		
P0705		◎	◎						…	◎	◎
P0802	◎			◎		◎			…		
P0903		◎				◎			…		
P0907									…		
P0909									…		
P1002		◎					◎		…		
P1003						◎	◎		…	◎	◎
P1005	◎	◎	◎	◎	◎	◎		◎	…	◎	◎
P1007			○				○		…	○	○
P1008	◎	◎		◎		◎		◎	…		
AC1	○	○	○			○	○		…		○
AC2						◎	◎		…		
AC3	◎			◎					…		
AC4									…		
AC5									…		
AC6									…		
I1									…	◎	◎
I2									…	◎	◎
I3									…		

◎：records to prove the truth
○：records to calculate compensation amount

4. Develop Construction Claim Decision-Making System

In order to automate claim examination and documentation, this research integrates the step-by-step process established in previous stage. Conduct with object-oriented (OO) technique to develop a Construction Claim Decision Making System (CCDMS).

System Analysis and Design

In the purpose of the analysis and design phase, study has adopted UML to identify user requirements, system operation and system architectural. The essential use case diagram of the system is shown in *Figure 5*. This diagram presents a dialogue between the actor and the system. The three-tier architecture system is established. In the application logic layer, which includes User management module, Case management module and Claim process module.

System Demonstration

Take Claim process module as an example, the operation steps are described as follow:
(*1*).*Create a new claim case and select dispute issues*

Users are able to create a new claim case name and select dispute issues due to owners or force majeure happen in the case; system provides "Case Inquiry" bottom to provide users refer other simulate cases for dispute issues selection.
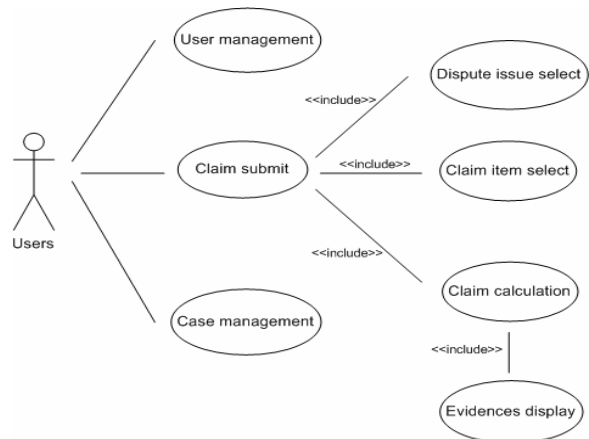(*2*).*Input EOT and select claim item*

Based on dispute causes of which users are selected, system automatically displays the suggestion list of claim items including items which should be listed and items listed according to actual circumstances.
(*3*).*Calculation of Claim quantum*

System shows estimate formula of each claim item according to claim item user has been chosen. Also, system provides "Evidence Inquiry" bottom. It can list the daily records that user can inquire numerical data to assist damages calculation, to prove the truth and related management process.
(*4*).*Print Result*

System display suggests compensation result show in *Figure 6*. The result includes claim case name, dispute causes, total amount of compensation and extension of contract time.

Figure 5 System use case diagram

Figure 6 Suggests compensation result

5. CONCLUSION

This research can be concluded as follows:

Summarization of dispute issues

Construction claim identification involves "timely" and "accurate" detection of a construction claim. Some construction claims of excellent merit are lost solely due to failure of identifying them. Thus, study summarizes most common dispute issues occur in the construction contract, provides construction manager or engineer not only prevents potential construction claims, but also avoids dispute issues on the construction site.

Correspondence between claim item and dispute issues

Study examines correspondence between claim item and dispute issues. It helps construction manager or engineer select common remedies for claim based on dispute issues. It also lists claim items according to the actual circumstances. Claim participants can examine the actually condition on site and chose possible claim item without missing compensation rights.

Relation between claim item and management Process/ records

Study uses eEPC diagram to represent the records in every GC's management process. Collect management records can be used for evidence, including records to prove truths and records to calculate the damages. This is useful not only in collecting evidence during claim documentation stage, but also reminding engineers to pay attention to certain records of which process should be carefully recorded and preserved in daily management.

Construction Claim Decision Making System

Study adopts object-oriented technique to develop a CCDMS. System displays the entitlement and quantum for assisting claim presentation. In addition, system is composed by reusable object; therefore, user can modify system without changing the entire system.

6. REFERENCES

AbouRizk, S. M., and Dozzi, S. P. (1993). "Application of computer simulation in resolving construction disputes." J. Constr. Eng. Manage., 119(2), 355–373.

Easton, G. R. (1989). "Construction claims." Dept. of Civ. Engrg., Loughborough University, U.K.

Jervis, B., and Levin, P. (1988). Construction Law, McGraw-Hill, New

Scheer A. W., (1994). Business Process Engineering: Reference Models for Industrial Enterprises. Springer-Verlag, New York.

Stokes, McNeill, (1977). Construction law in contractors' language. McGraw-Hill, New York.

Su, jin-jiang (1997) "Analysis of Construction Arbitration Cases." Business Arbitration，(35), 87-99.