

Process Model for Administrating Construction Claims

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Abstract: Claims for additional costs and time extensions result from a variety of events occurring during the course of construction. To enhance the chances of success, contractors submitting claims must closely follow the steps stipulated in the contract conditions, provide a breakdown of alleged additional costs and time, and present sufficient documentation. On the other hand, project owners need to follow an overall comprehensive step-by-step procedure for tracking and managing the claims submitted by contractors. The paper presents a claims-management process that could be used by all parties involved in construction. The process identifies the major information-gathering and decision-making milestones as well as the notice and substantiation compliance checkpoints, which are critical to the development of defense arguments as claims are addressed. It further emphasizes the use of tools such as simulation, scheduling, productivity, and economic analysis and other modeling techniques in judging the level of justification and reasonableness of submitted claims.

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Introduction

Construction projects are becoming more and more complex due to new standards, advanced technologies, and owner-desired additions and changes. While the successful completion of projects has been thought to depend mainly on cooperation between the contractor, consultant, and owner, problems and disputes have always erupted due to conflicting opinions as to the various aspects of design and construction.

With the introduction and widespread application of contemporary period analysis (CPM) scheduling, it became easier to point out where the delays are occurring and how delays in one activity affect others, and possibly the project as a whole, thus allowing objective judgments as to whether contractors should be entitled to time extensions. On the other hand, the increased complexity of construction processes, documents, and conditions of contracts has been contributing to higher possibilities of disputes, conflicting interpretations, and adversarial attitudes. The exhausting and expensive process of litigation has not been making things easier, as unsettled claims that have developed into disputes can take a very long time to be resolved. All the above factors have made "claims" an inevitable burden in implementing today's construction projects.

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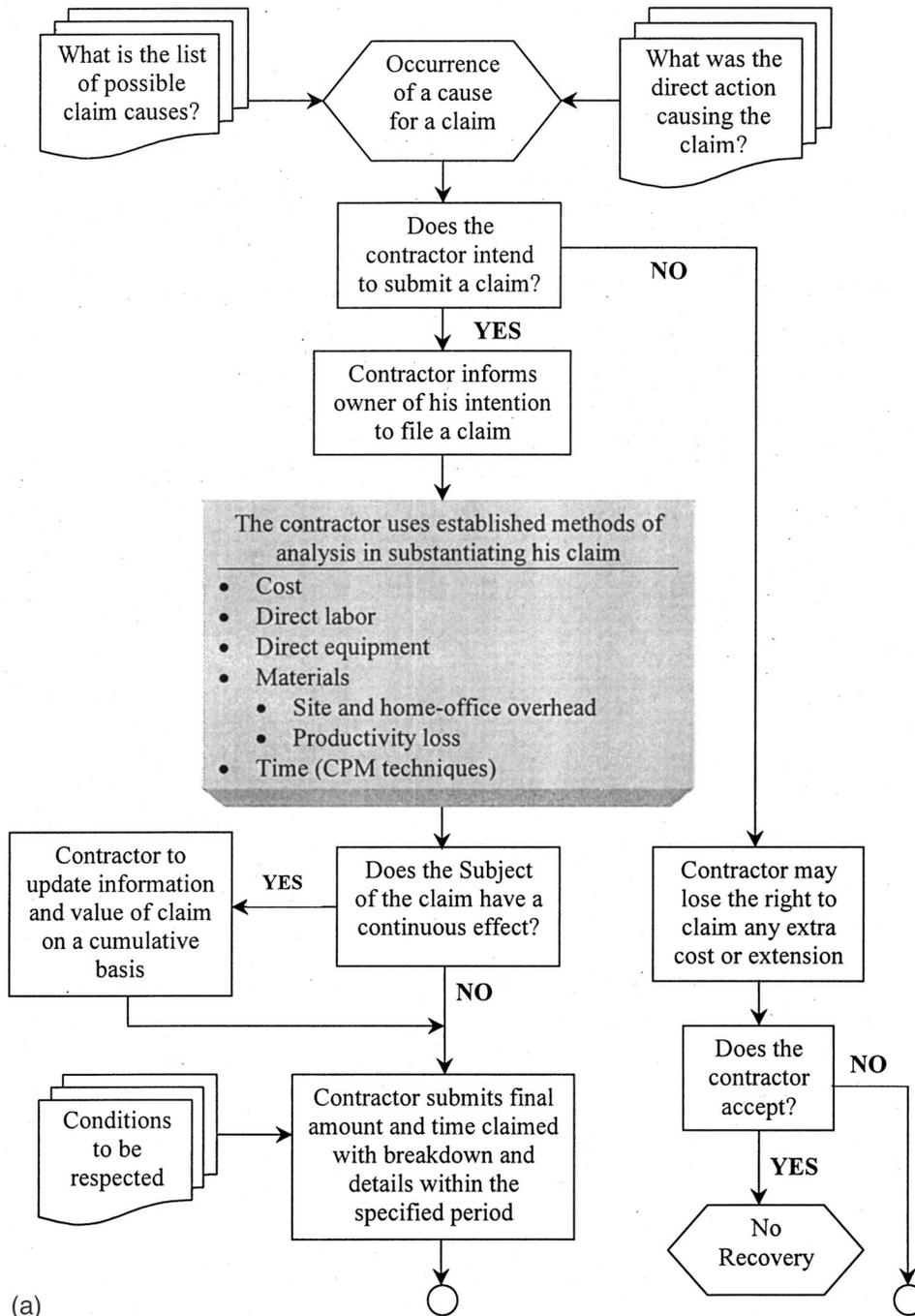
Difficulties with Claims

In the construction industry, where contract documents define rights, obligations, and procedures, a claim is a request by the contractor for an extension of time and/or additional cost and can evolve into a disagreement that may not be amicably resolved by the parties concerned (Clough and Sears 1979; Jervis and Levin 1988; Barrie and Paulson 1992). In any construction project, significant additional costs can be experienced by the contractor, the owner, or both, due to the actions of the other party or parties involved. Disputes over the right to a compensation as well as over the amount of time and/or money to be given often necessitate a resort to litigation, arbitration, or other forms of dispute-resolution methods for settlement (Muller 1990; Steen 1994; Keith 1997; Schumacher 1997). Claims and disputes arise from a number of cases, namely defective specifications (Thomas et al. 1994, 1995), differing site conditions (Thomas et al. 1992), increase in scope of work, restricted access to site, owner-caused disruptions or delays (De La Garza et al. 1991), disagreement as to what constitutes a substantial completion, interpretation of site instructions, and enforcement of liquidated damages, among others.

It is important for the owner, when analyzing a claim presented by the contractor, to ask the following questions (Bubbers and Christian 1992; FIDIC 1992): Were the contract requirements met (Thomas et al. 1990)? Did the contractor refer to the proper clauses in the contract? Does the owner or consultant bear part of the responsibility? Was the situation predictable at the time the contract was signed? Were the specifications defective? Was the contract misinterpreted? And, if so, which competing interpretation will rule?

Claims-Tracking Process Model

A need for an overall step-by-step procedure for claims analysis and administration is therefore crucial for achieving proper resolutions and for preventing claims from developing into disputes. Fig. 1 shows the sequence of events and procedures that any



(a)

Fig. 1. Claims administration model

claim would have to pass through before being resolved. Although the process is general to a certain extent, each particular node can be further developed, depending on the peculiarities of each claim and project. Some of the nodes are subprocesses by themselves and will be highlighted in the course of the following discussion.

Occurrence of Cause for Claim

This event is mainly affected by two things: recognition of the possible categories of claims causes, and direct actions on site that initiate the claim. That is, awareness—on the part of the contractor—of work aspects that are susceptible to claims shall

first exist, while the claim is only initiated when it is perceived by the contractor that a triggering action on the part of the owner or engineer has taken place.

Does Contractor Intend to Submit Claim?

Following the occurrence of a claim-triggering event, the contractor makes a careful analysis of the situation and weighs its options. The contractor may decide not to pursue the claim for many reasons: The grounds for the claim may be shaky, and the contractor may want to preserve good relations with the owner or may feel that the subject of the claim is of little significance and can be handled informally.

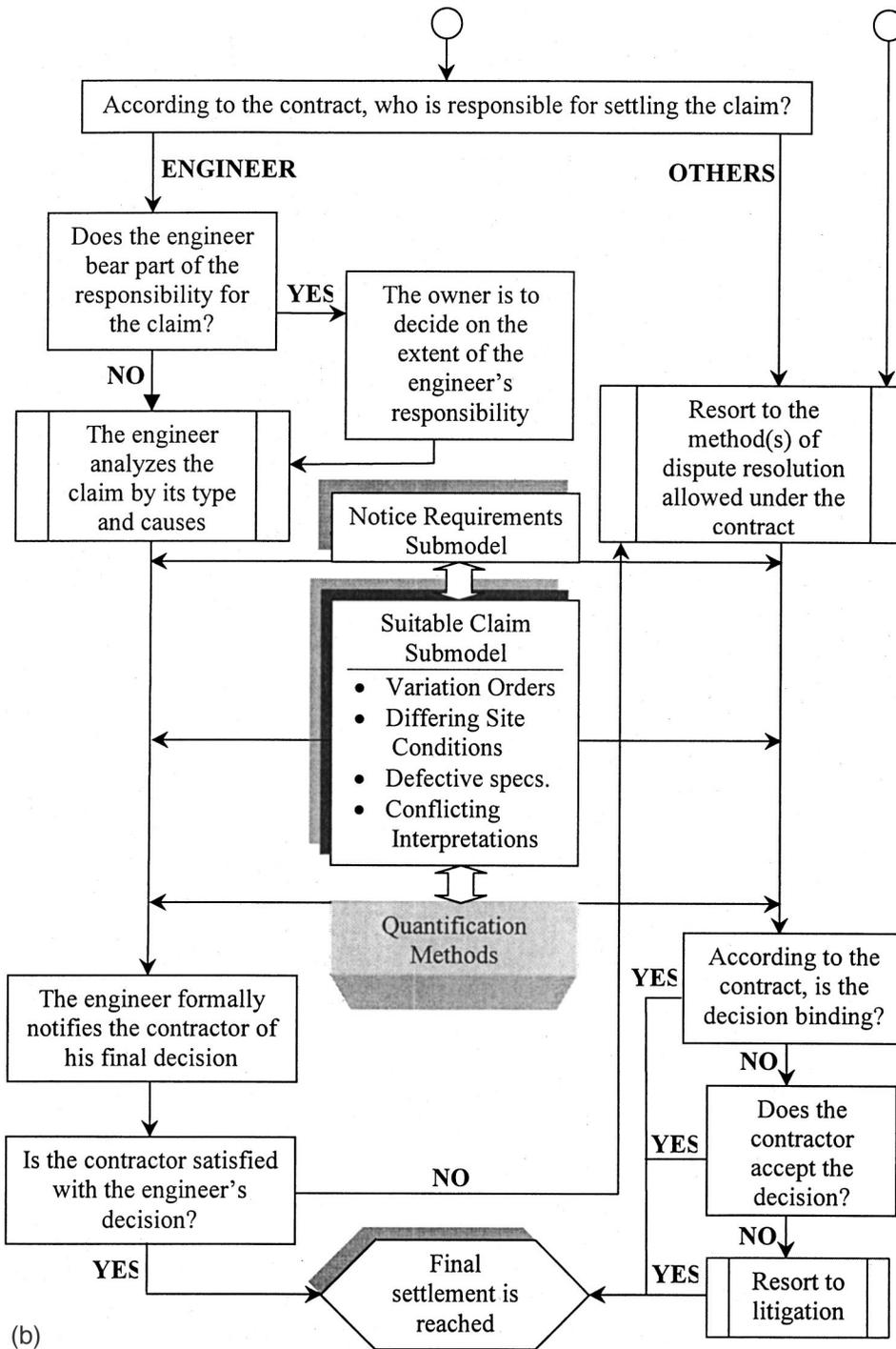


Fig. 1. (Continued)

On the other hand, the contractor may decide to go ahead with the claim. This decision requires that notification requirements be met in that the contractor's intention to claim any extra time and/or money must be made in writing to the owner directly after the occurrence of the cause of a claim, or soon thereafter. This is vital, although the contractor may not have had a chance to assess the amount of time and/or money he intends to recover. The notification shall make a clear reference to the clause(s) of the contract under which time or cost recovery is sought. Failing to fulfill the notice requirements, the contractor may lose its right to any claim of extra time and/or money under the contract. This is be-

cause a timely notification is regarded as a chance for the owner to reassess the situation and, if needed, to ask the contractor to discard what was thought of by the engineer or the owner to be constructive remarks.

Contractor uses Established Methods of Analysis in Substantiating His Claim

The contractor has a key task of substantiating the claim, that is, defending it and proving the validity of its content. Generally speaking, the items claimed by the contractor fall under two

major categories: time and cost. In the first category, the contractor requests a modification of contract delivery dates and milestones to offset the delays that it did not cause. In the second category, the contractor asks for reimbursement to cover the following items (Semple et al. 1994): premium time, increased equipment cost (rental or ownership), increased financing costs, increased site overhead, increased home office overhead, and decreased labor productivity. 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.

In the following, the common quantification methods used by the contractor are presented. Note that the same methods are used by the party resolving the claim (engineer or others) to check the authenticity of the contractor's calculations.

Delay Estimation: CPM Techniques

The use of CPM networks and bar charts for claim analysis dates back to the early 1970s (Wickwire and Smith 1974). The advent of computer software that performs this type of calculations has further enhanced their acceptability. Judges and lawyers have become quite adept at understanding them.

CPM analysis is useful in identifying the components of delay, attributing each part to the party responsible for it, and studying the overall impacts on the project schedule. There are three established delay analysis techniques (Schumacher 1997; Bubshait and Cunningham 1998) the "what-if technique," the "but-for technique," and the "time impact analysis."

The third is superior to the first two methods in that it relies on CPM updates to determine the true critical path at different points in time. This allows an accurate representation of the status of work at the time when the delay occurred. Hence, this method studies the effects of delay as "the project participants would have done at the time" (Schumacher 1997). This is why it is also known as "contemporaneous period analysis" (CPM). Even if no CPM update is available for the period of the delay, an update can always be recreated from project records (assuming that such records exist). Alternatively, if a delay occurred between two updates, interpolation can be used to determine the status of float at the time of the delay. However, this interpolation may lead to unreliable results because labor productivity may not vary in a linear fashion (Bubshait and Cunningham 1998).

Productivity-Loss Estimation Methods

Claims for productivity losses are generally a cause of tension between the contractor and the owner. This is due to the great difficulty involved in quantifying disruption effects. The situation is further complicated when the contractor's claim includes the "ripple effect," that is, a request for compensation for activities whose productivity suffered indirectly due to the owner's actions. The owner is usually reluctant to accept the existence of this ripple effect because it is not readily seen and because it may be used to cover up the inefficiency caused by the contractor's mismanagement. All in all, the parties may disagree on productivity-loss issues, even when they have agreed on the presence of delays.

In brief, the owner's actions can cause disruption and hence reduction in productivity by the following means (Finke 1998; Hanna et al. 1999a, b): work-area congestion, stacking of trades, resource diversion, overtime, low morale, and dilution of supervision. In order to quantify the loss in productivity, the contractor

can resort to any of the six identified methods addressed below.

1. The total cost method calls for the contractor to try to recover the entire man-hour overrun by claiming the difference between the total incurred cost and the bid cost (Kallo 1996; Finke 1998). Obviously, this method is favorable to the contractor because it is easy to produce and it maximizes potential recovery. However, it can only be used if the situation is so complex that it defies analysis, the bid and actual costs are reasonable, and the contractor is not liable for the loss in work efficiency. Given that the previous conditions are satisfied, the total cost method is still deficient (Finke 1998), in that it cannot be used before project completion (when all man-hour records are available) and that it produces a lump-sum result (not activity-specific). For these reasons, the use of the above method can be controversial. The court case outcome may hang on the presentation skills of the disputing parties (Barrie and Paulson 1992).
2. The modified total cost method (Kallo 1996; Barrie and Paulson 1992) represents an improvement of the total cost method by refining the original estimate of cost. The items removed include errors in bid estimates, activities unaffected by owner-caused disruptions, excusable noncompensable delays, unaffected subcontractor work, and work done at a profit. Moreover, the contractor's bid estimate is validated by comparing it to the bid estimates of the other bidders. This is definitely an improvement over the previous method, but it still suffers the same two deficiencies (lump-sum result, and need to wait for the project's end to evaluate losses).
3. The factor-based methods apply "lost-efficiency factors" to the original estimate of man-hours required for the disrupted activities. The increase in man-hours is then claimed. These factors are based on changed work conditions, project characteristics, historical data, and expert opinion (Finke 1998; Kallo 1996). They can be found in industry publications (plotted in graphs), the most notable being those of the Business Roundtable. Alternatively, they can be calculated from equations, such as the "forward-pricing formula" (Kasen and Oblas 1996), which relates the total impact of changes to such factors as float, timeliness of notice to proceed with the change, and monetary value of the changes made. The disadvantages of the factor-based methods are many. The factors used are highly speculative and require substantial supporting documentation. Moreover, there are no activity-specific sets of factors, but rather factors for the project as a whole. Even if such factors were to be developed, they would still need calibration to reflect the peculiarities of the project and the contractor work force. Therefore, factor-based methods should be used for reference purposes only.
4. The baseline method is yet another method that relies on the contractor's bid estimate. The difference between this method and the total-cost method is that the baseline method selects impacted activities with a major cost impact as claim items, rather than attempting to recover cost overruns for the project as a whole. This is based on Pareto's principle, which is to the effect that "approximately 20% of work items will account for approximately 80% of the cost" (Barrie and Paulson 1992). This method, while it may be considered an improvement over the total-cost method, still requires a lot of documentation to prove the reasonableness of the contractor's bid estimate.
5. The modified baseline method (Barrie and Paulson 1992) avoids the pitfalls of the previous methods by taking for a baseline the actual costs incurred by the contractor. The idea is to compare the productivity (expressed in time/unit or as a

cost figure) in impacted periods to that in unimpacted periods. Needless to say, the compared work activities should be of a similar nature, and the chosen unimpacted work activity should be truly representative of normal work conditions. This method is also referred to as “measured mile comparisons” (Finke 1998) and “comparison of productivity levels” or “cause-and-effect method” (Kallo 1996). Given that actual man-hour records are available, the modified baseline method preferred over all the previous methods.

6. Finke (1998) presents an interesting methodology to estimate disruption effects, which he calls “disruption distribution.” It models the relationships between activities using quantitative and qualitative factors, which are derived from specific circumstances and project characteristics, and it works by starting with the work activities directly affected and then distributing the disruption to other activities (very similar to the moment-distribution method used in structural analysis).

Other studies have tried to model the loss in productivity as a function of other variables. Two other studies attempt to predict the impact of change orders on labor productivity for mechanical and electrical construction using statistical regression to produce an equation for the loss in labor efficiency (Hanna et al. 1999a, b). However, the suitability of such models to a particular project remains to be doubted, and they are hence more suitable as guiding references.

It remains to be stated that productivity-loss estimation methods serve a dual purpose. Not only are they useful in claim analysis, but, if conducted in a timely manner, they also allow the contractor to utilize the available float to mitigate the effects of the disruption (by rescheduling of activities, reassigning crews, and so on). This is very important in the sense that the contractor may forfeit its right to claim damages if proven to have anticipated the disruption effects but to have done nothing to mitigate them or lessen their impact.

Simulation Techniques

The methods discussed so far utilize a macro approach to tackle the claim case. Simulation, on the other hand, takes the micro approach. In simulation, we zoom into each individual activity and determine the different resources and tasks it involves. Simulation models portray the sequence of tasks to be done and the resources to be utilized to complete the activity. Simulation offers many advantages, such as the ability to carry out sensitivity analysis, and hence it allows the estimation of the effects of disruptions. In addition, it incorporates the uncertainty involved in construction and models the complex nature of resource interactions (AbouRizk and Dozzi 1993).

One dominant simulation technique is the CYCLONE model, which was developed for simulating construction operations (Halpin and Riggs 1992). The model can be instrumental in resolving construction claims and disputes. Conditions that must be met for its successful use are as follows (AbouRizk and Dozzi 1993):

1. The operation should be of a cyclic (repetitive) nature;
2. The operation should be easy to model, and the mediator should have extensive knowledge in the field in order to construct a useful model;
3. The disputing parties should have the right mind-set to accept the implementation of this technique; and
4. The parties should have access to easy-to-use simulation software, such as the MicroCYCLONE simulation system.

Estimating Cost Items

Compared to delay analysis and productivity-loss estimation, the quantification of “direct cost items” is a relatively simple issue. By direct cost items, we mean those cost categories in which the increase in cost can be easily proved and valued. Increased equipment and financing costs are examples of such items. On the other hand, we find items that are not so easily quantifiable, such as home-office overhead. This section presents the different cost categories that may be the subjects of alleged claims and the means to substantiate such costs:

- **Increased labor costs:** These are divided into direct and indirect labor costs. An increase in direct labor costs usually refers to those activities directly influenced by the owner’s disruption. This increase can be obtained from actual labor work records (which show the increase in work duration) by applying the labor rates used by the contractor. The contractor is also entitled to compensation to cover any increase in wage rates that may occur during the delay period (Barrie and Paulson 1992). By indirect costs, we mean the costs associated with activities indirectly affected by the disruption (ripple effect). These costs are estimated using any of the productivity-loss estimation techniques discussed earlier, after the scope of disruption has been determined.
- **Increased equipment and material costs:** The increase in equipment cost is calculated from the delay period and the rates charged by the contractor for the use of different equipment. Equipment idle times are derived from equipment work records, which show the number, type, capacity, and usage of equipment on a daily basis. Estimating increases in material costs is also straightforward and can be done by comparing actual and revised drawings and by referring to materials records, which give the quantity and description of materials brought to site.
- **Increased financing costs:** Due to delays, the contractor suffers increased financing charges on the overdraft accounts secured to finance the construction process. To justify its claim, the contractor should disclose all its trading accounts, so that the quoted interest may be accepted. Otherwise, the current rate of borrowing is adopted (Vidogah and Ndekugri 1997). Also, the contractor may claim inflation costs if the delay period was of such length as to warrant it.
- **Increased overhead costs:** This includes both site overhead and home-office overhead. An increase in site overhead expenses is usually easier to quantify. It requires the contractor to disclose its buildup of site preliminaries, showing detailed costs for all items considered as general site items (site infrastructure, cranes, and other general site equipment). Quantifying the home-office overhead increase, on the other hand, is a tricky business. It is not very clear how home-office expenses are affected by site delays. Contractors refer to this item as unabsorbed home-office overhead because a greater portion of the home-office workforce time is allocated to the delayed project for the same total payment amounts received from the owner. There is no clear-cut method to quantify increased home-office overhead, but researchers have come up with many estimation formulas. For instance, two famous formulas in the U.K. are the Hudson formula and the Emden formula (Vidogah and Ndekugri 1997). In the United States, the Eichleay formula has gained wide acceptance. In brief, this formula first multiplies the total home-office overhead for the contract period by the ratio of delayed-project billings to total billings in that period. This gives the portion of home-office overhead allocable to the delayed project. Then, multiplying

this last quantity by the percentage delay (total delay divided by total project duration) gives the unabsorbed home-office overhead (Jervis and Levin 1988).

Does Subject of Claim Have Continuous Effect?

It is necessary to note if the subject of the claim has a continuous effect. If the effect on the program and budget can be directly assessed after the occurrence of the cause for a claim, there will then be no continuous effect. On the other hand, if the consequences resulting from the claim are not foreseeable or cannot be measured at the time the contractor notifies the owner, the claim in this case has a continuous effect. Here, the contractor is asked to give an account with details of the amount claimed and the grounds upon which the claim is based. The contractor shall at intervals, as the engineer may reasonably require, send further interim accounts stating the accumulated amount of the claim and any further grounds upon which it is based (FIDIC 1992).

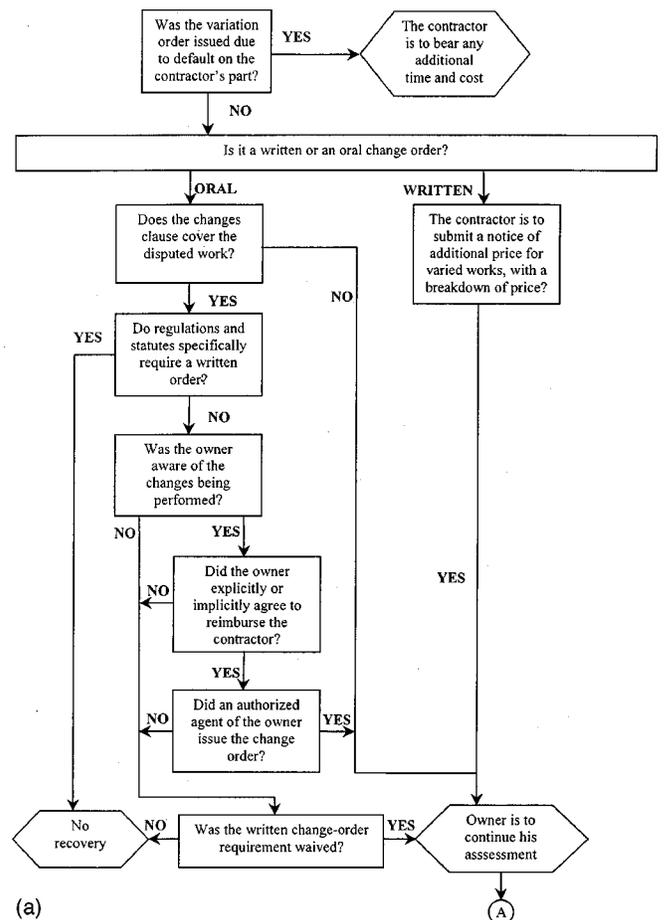
Timely Substantiation Submittals

The contractor is then to submit the final amount of time and/or money claimed within a period specified in the contract from the end of the effects resulting from the occurrence of the cause for the claim. The claim should be presented in a clear and logical manner, preferably including the following:

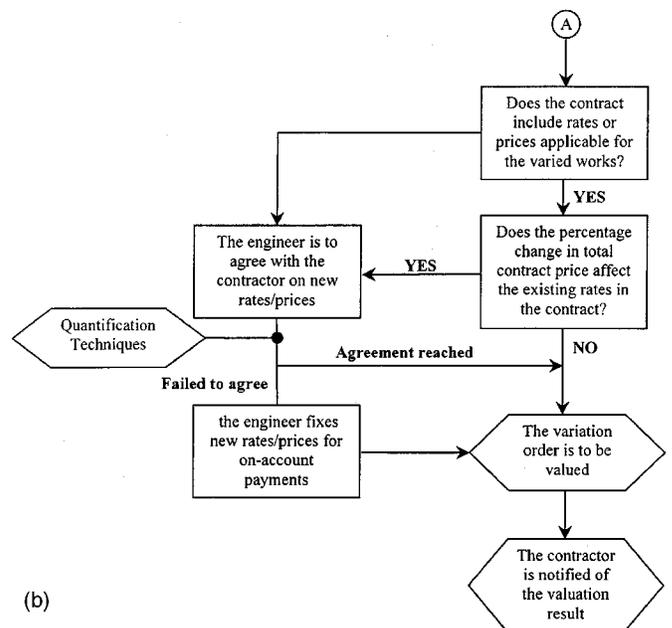
- An introduction providing details of the parties involved in the claim and all relevant dates and information;
- A description of the claim events as they occurred and their effects;
- An analysis of the facts showing the grounds upon which the claim was based, with reference to the relevant provisions and clauses of the contract;
- A description and reference to the steps already taken by the contractor, such as notices given;
- A calculation of the cost impact based on a breakdown of actual direct and indirect costs incurred; and
- A determination of the claimed extension of time based on an analysis of critical and noncritical delays;

The documentation usually required for claim analysis and documentation is derived from the following sources:

- Project correspondence;
- Conditions of contract and specifications;
- Construction schedules (original and updated);
- Site diaries (labor, equipment, and material records);
- Progress photographs and videos (with commentary);
- Minutes of site meetings;
- Records of delay and disturbance;
- Day-work records;
- Drawing register (details of amendments and revisions made to plans);
- Bills of quantities document;
- Contractor's breakdown of tender prices;
- Daily progress reports (date, weather, temperature, type and quantity of work, materials delivered, resource assignments and allocation, and so forth);
- Records of inspections and directions;
- Progress payment applications and certificates;
- Delivery records of owner-furnished equipment and materials;
- Register of submittals (shop drawings, materials samples and vendor's brochures, falsework calculations, scaffold design, bar-bending schedule, and so forth);
- Productivity and cost reports; and



(a)



(b)

Fig. 2. Variation orders submodel

- Accident and site safety report.

The node designated with "conditions to be respected" by the contractor represents a summary of what has been discussed up to this point. These conditions include meeting the notice requirements, submitting all the needed information with sufficient details to allow analysis of the claim, referring to the proper clauses

Table 1. Alternative Dispute Resolution Methods

| Method | Major participants | How it works |
|---------------------------|---|---|
| Direct negotiation | Representatives of parties | Representatives negotiate a settlement to the dispute |
| Mediation | Disputing parties, mediator | Mediator goes back and forth between parties in order to bridge differences |
| Nonbinding arbitration | Disputing parties, arbitration board | Parties present their cases, arbitration board makes nonbinding recommendations |
| Minitrial | Top managers of disputing parties, neutral member (three-member panel) | Managers present their cases and engage in negotiation, neutral panel member acts as advisor |
| Rent-a-judge | Disputing parties, judge | Judge (active or retired) presides over informal trial where parties present their cases |
| Dispute resolution boards | One representative for each side, third member chosen by other two (three-member panel) | Panel is formed at onset of project and is thus familiar with project details and work progress. Panel looks into all arising disputes and passes nonbinding judgment |

in the contract, and not disrupting the progress of work due to the occurrence of the cause for the claim.

According to Contract, Who Is Responsible for Settling Claim?

The party responsible for settling the claim and giving the final decision should be clearly specified in the contract. Usually the engineer or a consultant designated by the owner is responsible for deciding the outcome of the claim. Often, it is stated in the contract that if amicable settlements are not achieved, other dispute-resolution methods can be used, such as arbitration, mediation, dispute resolution boards, and litigation.

Does Engineer Bear Part of Responsibility for Claim?

At this point, the owner has to check and decide whether the engineer is responsible in part for the occurrence of the cause for the claim. The owner has to address the following questions carefully: Was the cause of the claim linked to a delinquency on the part of the engineer? Was the design defective or incomplete? The owner is usually bound by the actions of the engineer on site. That is why the engineer has to make sure that any action he or she takes is consistent with the terms of the contract. If any of the engineer's actions prove inconsistent with the contract terms, the contractor may become entitled to the appropriate compensation, which will then have to be paid by the owner (Jervis and Levin 1988). The engineer may sometimes be reluctant to admit mistakes, such as defects in the design or misrepresentation of existing conditions. To this effect, the engineer might issue site instructions or indicate remarks on the contractor's submittals in an attempt to correct or complete the design.

The owner, however, has to decide if the engineer was responsible. Ultimately, it is the owner who will pay any extra amount, and it is the owner's project that may be delayed if the claim involves a request for a time extension. If the engineer turns out to bear part of the blame, the owner can make the engineer pay

for any mistakes he or she made, either by asking to redesign certain items at no extra fee or by reducing the premium. In extreme cases, the owner can even relieve the engineer of its obligations and call upon the engineer's professional liability provider to pay for damages resulting from the engineer's default.

Engineer Analyzes Claim by Its Type and Causes

In all cases, the engineer is expected to make an independent, objective judgment of the situation. The engineer should act impartially, whatever the outcome of the claim may be, and he or she is obliged to recommend that the contractor be given what-

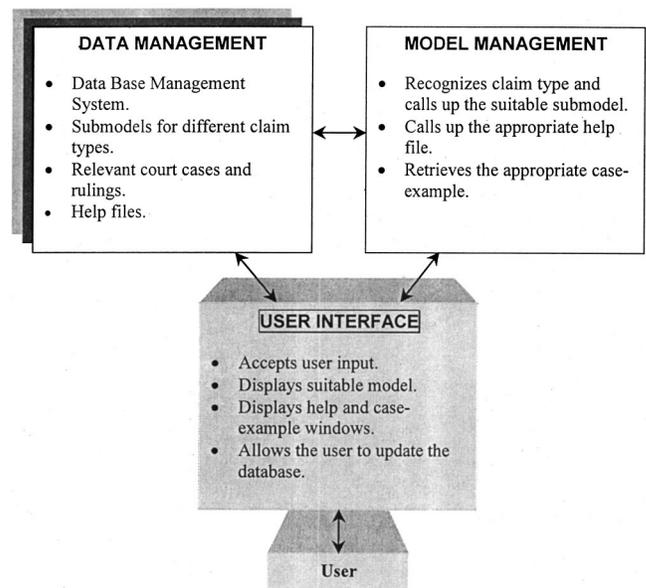


Fig. 3. Structure of decision support system

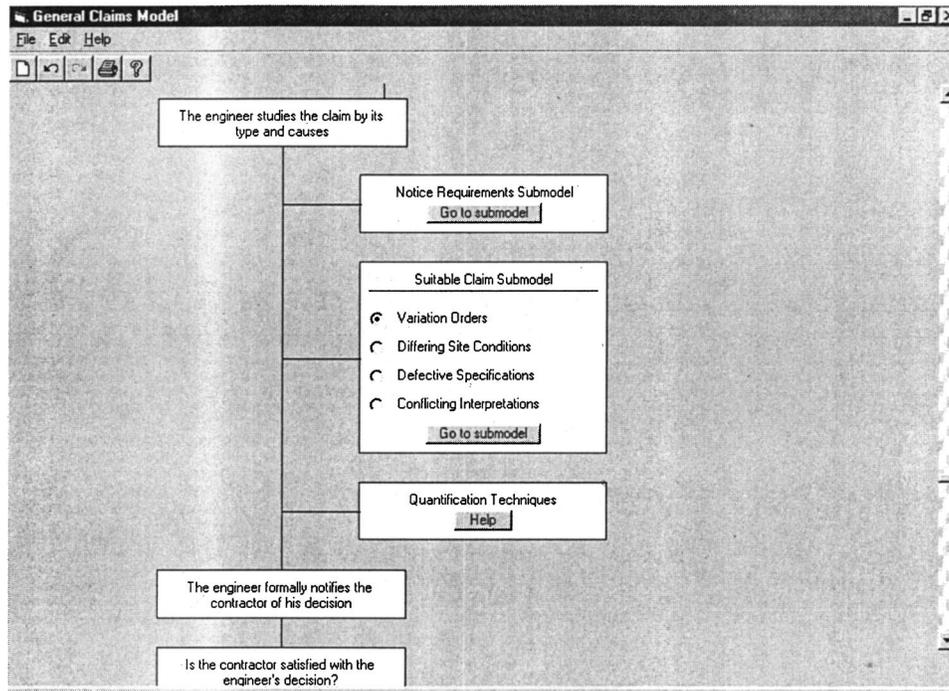


Fig. 4. Screen from general claims model

ever it is rightfully entitled to under the contract. Once the engineer has the claim fully documented in hand, he or she will proceed with the analysis based on the claim's type and its causes. The tools used for the analysis are the "notice requirements" submodel, subprocesses for analysis of the most common types of claims (such as differing site conditions, defective specifications, conflicting interpretations, and variation orders), and quantification methods for estimating cost and time entitlement.

Notice Requirements Submodel

Thomas et al. (1990) present a model for checking if the contractor adhered to notice requirements. In brief, the model stipulates that the contractor loses the right to claim if any of the following conditions is met:

- The engineer was not formally notified of the occurrence of the cause for a claim;
- The contractor did not submit its notice within the allowed duration;
- The contractor did not state that it expects extra time or money; and
- The owner was prejudiced due to lack of notice.

Differing-Site-Conditions Submodel

Thomas et al. (1992) present a model for dealing with differing-site-conditions claims. Any of the following conditions, if satisfied, would preclude recovery of cost and time:

- The contract documents were fairly accurate in representing site conditions;
- The contract documents do not portray site conditions, but those site conditions do not differ materially from conditions ordinarily encountered in work of similar character; and
- The contractor relied blindly on the described conditions when a simple site visit would have shown discrepancies between actual and depicted conditions.

Defective Specifications Submodel

The process for dealing with the "defective specifications" type of claims was introduced by Thomas et al. (1995). Depending on the way the specifications were written, two cases arise: (1) Where the specifications describe the performance for the work to be achieved, the specifications are said to be of the performance type. In this case the contractor has the choice of the method it wants to use and bears a great risk in producing the desired end result. If the contractor can show that the described performance was impossible to achieve by any reasonable method and that it did not assume the risk of achieving the specified performance, either through a clause in the contract or through its own actions, then the contractor is likely to recover any additional cost for the correction of the work.

On the other hand, (2) if the specification clearly stated the method to be used in performing the work, the specifications are said to be of the method type. If the failure occurred before the completion of construction, then the contractor is unlikely to recover any costs since it is usually responsible for protecting the works during the construction phase, unless it can prove that the failure would have occurred even if the construction was complete. In this case, where the defect was obvious, the contractor should have brought it to the owner's attention. If not, recovery of cost by the contractor is unlikely. If the contractor deviated from the specifications due to an observed defect, then he or she should have secured the owner's approval of such deviation. Finally, the contractor might not recover if it assumed the risk of defective specifications under the contract conditions.

Conflicting Interpretations Submodel

Thomas et al. (1994) present a model for dealing with claims arising from conflicting interpretations of the contract documents. Four issues are checked:

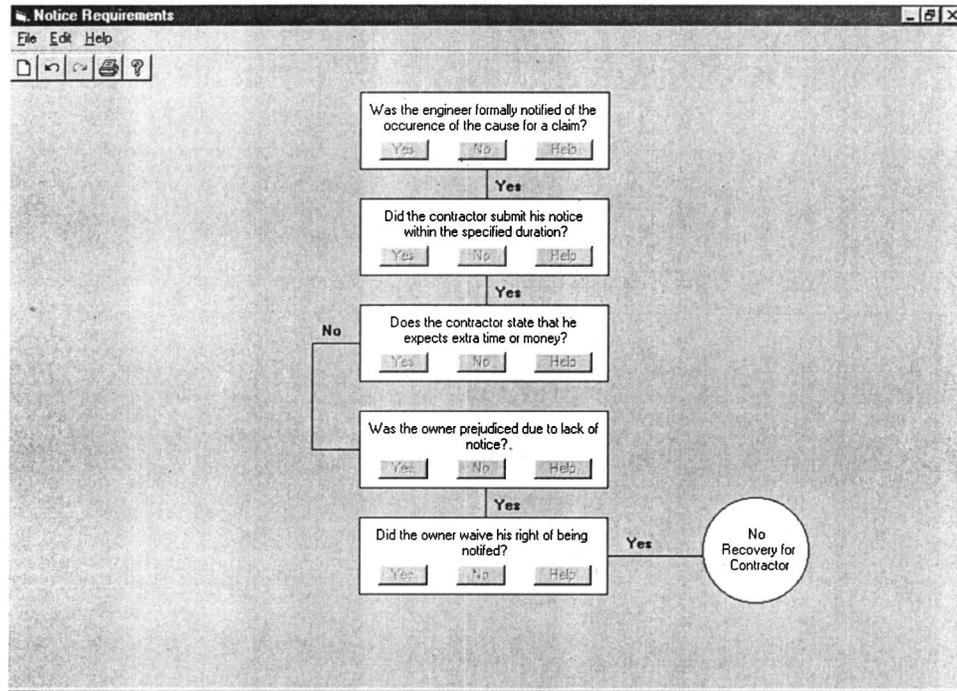


Fig. 5. Notice requirements submodel screen

- If the terms used have a plain meaning or a trade meaning, then that meaning is adopted;
- If the documents were so vague and ambiguous that the contractor should have inquired about their true purpose, then the owner's interpretation prevails;
- If the past actions of the parties convey a mutual understanding (set a precedent), then this mutual agreement prevails over the written requirements;
- If the contract is read as a whole, so as to understand the purpose of each section and the interrelationship between different sections, and more than one logical interpretation can be reached, then the "order-of-precedence" clause is checked to determine which of the conflicting documents govern. Otherwise, the "construed against the drafter" rule applies; that is, the contractor's interpretation governs.

Variation Orders Submodel

Thomas et al. (1991) present a model for resolving "oral change order" claims. Fig. 2 presents a unified general model for all variation order claims, both written and oral.

Variation orders are formal requests by the owner to change the scope (quantity) and/or the quality of part(s) of the works constituting the contract. The claim in this case will result from two possibilities: (1) disagreement over whether an extension of time is due for performing the varied works; or (2) disagreement on the rates to be applied to the varied works. The process presented in Fig. 2 does not, however, cover the issue of claimed extension of time.

Quantification Methods

If the analysis shows that the contractor has valid grounds for a claim, the engineer now has the task of quantifying the amount of compensation (in terms of cost and time) that the contractor is entitled to. To achieve this purpose, the engineer has to resort to the very same quantification methods proposed earlier for the use

by the contractor to substantiate the claim. Therefore, no further discussion of these methods is required.

Engineer Formally Notifies Contractor of Final Decision

The contractor, however, is not ultimately bound by the engineer's decision. Usually, the contractor can dispute the engineer's decision and has the right to resort to arbitration, litigation, or other dispute resolution methods, as stipulated by the contract.

Resort to Alternative Dispute Resolution Methods Allowed under the Contract

It is useful at this stage to present the alternatives that the contractor may resort to in order to open an engineer's decision. Traditionally, contractors used to take their grievances directly to court. Litigation is beneficial in that it is not a hasty process, but gives the disputing parties enough time to analyze the situation and prepare their cases. However, the increasing legal fees and unacceptably long trial periods, coupled with the contractor's desire to maintain good relations with the owner, have made this alternative considerably less desirable (Muller 1990; Treacy 1995). Binding arbitration presented itself as a cheaper and faster means of resolving claims; however, it suffers many disadvantages, most notably the slowness of the process (due to the busy schedules of the arbitrators), the admissibility of hearsay (not allowed in courts), and the finality of the decision (Patterson 1997).

Alternative dispute resolution (ADR) methods are means of resolving claim cases quickly and painlessly. They enjoy a number of advantages over litigation and binding arbitration (Treacy 1995; Patterson 1997): informal atmosphere (easier communication), less cost and time, maintaining a working relationship among the parties, confidentiality of proceedings, and nonbinding decision. The most common forms of ADR are shown in Table 1

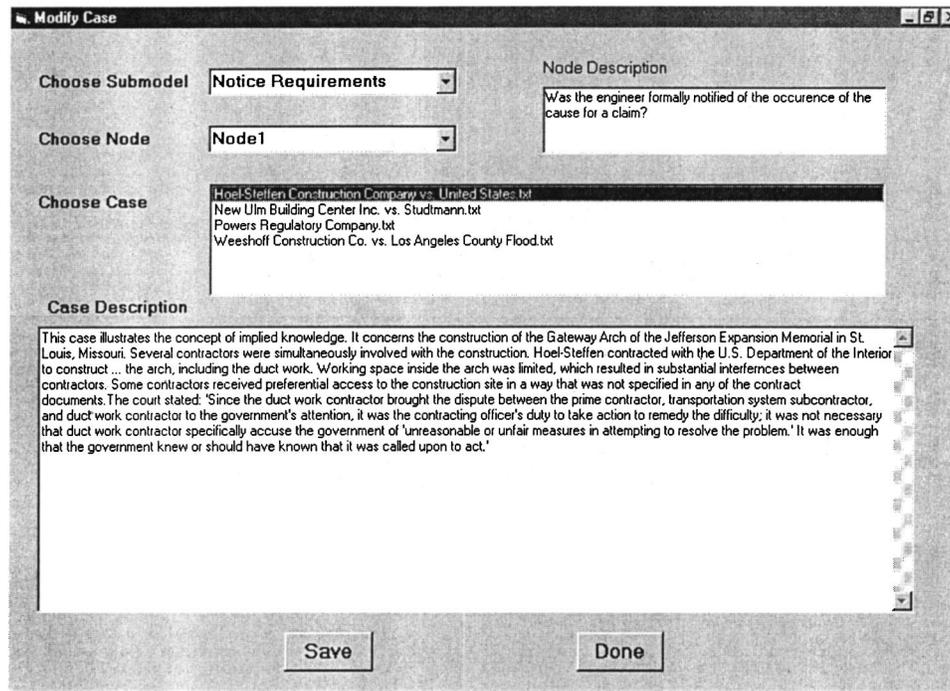


Fig. 6. Form used to modify case pertaining to node

(Muller 1990; Steen 1994; Treacy 1995; Keith 1997; Patterson 1997). Other ADR methods include variations on the above methods, such as court-appointed masters, expert resolution, and med-arb (a combination of mediation and arbitration).

Automating the Process

The presented process, with all its subprocesses, has been developed into an automated decision analysis tool using Visual Basic as a programming platform. Bubbers and Christian (1992) suggested the use of a hypertext software for implementing a computerized version of similar models. Fig. 3 shows the structure of this decision-support system.

The automated system, called CLAIMS MANAGER 2000 and described under a different publication title, has been tested and debugged and features the following:

- The general claims model, which incorporates five submodels, as shown as part of the program's screen in Fig. 4, four of which guide the user through the analysis of the different claim types (differing site conditions, variation orders, defective specifications, and conflicting interpretations). The screen of the fifth submodel for checking adherence to notice requirements is shown in Fig. 5.
- An on-line help system that educates the user on the significance of each node and puts at his or her disposal a library of relevant claim cases and court rulings;
- An editor mode to allow the user to customize the help system by adding, modifying, or deleting cases. This gives the software the ability to expand. Fig. 6 shows the "modify case" screen of the notice requirements submodel;
- A printing facility to allow the reproduction of the logic used in reaching claim solutions (graphics printing), plus the customary printing facility for help files (text printing); and
- A user-friendly interface, allowing users accustomed to the Windows environment to feel "at home" with the software.

Concluding Remarks

This paper has presented a process model aimed at addressing the stages through which construction claims evolve. The outcomes from such a systematic claim event-screening exercise are likely to be more acceptable to all parties involved and thus reduce the likelihood of claims eventually developing into disputes, which can be costly to resolve.

The model is characterized by a number of major stations of tracking and analysis. These include satisfying notice requirements, claims' degree of substantiation and adopted methods of analysis and documentation, and the integration of developed, structured approaches for achieving decisions along four technical grounds. The automated version of this claim-tracking process seeks to impart a clear understanding of both the general and submodels' nodes so that the claim analyst is guided and positively critiqued throughout with relevant information and explanations as well as with sample court rulings.

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