Contractor's Approach to Offset the Consequences of Interim Payments Disruptions Caused by the Owner

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ABSTRACT

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The bidding stage of construction projects involves a high number of uncertainties due to its speculative nature. Difficult economic situations may force owners to disrupt interim payments to contractors due to the lack of available funds. This thesis identifies the consequences associated with payment disruptions and offers contractors a simple mathematical model that allows him/her to determine the consequences of receiving planned payments at a date later than expected. These consequences were offset by interpreting the outcomes as an allowance factor within the contractor's bid estimate. The logic behind this model is to quantify the added financing costs and the impact costs in terms of progress rates associated with the project using the current practices of contractors in the Canadian construction industry in terms of financing and estimating. A sample case study is included to demonstrate the proposed model. The model is recommended for only small and medium sized projects. It can be applied to related domains of estimating and planning within the area of construction management. In addition, it allows for further expansion and linkage to delay analysis systems enabling contractors to minimise uncertainties that exists at the pre-construction bidding stage of a project.

To my parents,

"Kind words can be short and easy to speak,

but their echoes are truly endless."

Mother Teresa.

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A_C	Circumstantial repayment figure ($)
A_D	Defined periodic repayment figure ($)
A_E	Effective activity duration
A_O	Original activity duration
$A_{O'}$	Activity adjustment duration
A_{O*}	Adjusted original activity duration
A_{RED}	Overall reduction in the critical activity's progress rate
A_L	Allowance needed to offset the consequences of the payment disruption ($)
$(A/P\ i,n)$	Capital recovery factor
C_F	Added financing costs (%)
C_{ET}	Effective total project cost ($)
C_P	Overall impact costs in terms of reduction in progress rate (%)
C_{OT}	Original total project cost ($)
$C_{<MARFD}$	Accumulated incurred costs up to the period of maximum reduction ($)
C_{RF}	Effective remaining cost ($)
C_{RO}	Original remaining cost ($)
CCR	Cumulative Cash Requirement ($)
CR_P	Periodic cash requirement ($)
$CR_{P'}$	Adjusted (weighted) periodic cash requirement ($)
CR_T	Total project cash requirement ($)

D	Money deposited to earn interest ($)
D_{RP}	Remaining project duration at period of maximum reduction
E_{PR}	Effective progress reduction on the remaining project duration (%)
F	Unused credit commission fee factor
$(F/P\ i,n)$	Single sum, future worth factor for nth period
i	Interest rate (%)
IC	Impacted cost on the remaining project cost due to the disruption ($)
I_D	Interest earned from deposit account ($)
I_{Dc}	Interest earned at period c ($)
I_L	Overall incurred interest from loan ($)
I_N	Net payable interest ($)
I_{Pa}	Interest payment at period a ($)
IR	Increase in remaining project duration index
I_{SD}	Interest earned from self-deposited funds ($)
LR_P	Periodic loan repayment amount comprising of the periodic principal and interest ($)
MCF	Maximum negative cash flow balance ($)
N	Number of Periods
n	Loan period
NCF_{DF}	Net cash flow balance under defined full financing ($)
NCF_{DP}	Net cash flow balance under defined partial financing ($)
NCF_{CF}	Net cash flow balance under circumstantial full financing ($)

$NCF_{C,P}$ Net cash flow balance under circumstantial partial financing ($)

P Loan money drawn ($)

P_D Delayed project duration ($P_D = P_O + y$);

y = Period by which payment disruption sustains

P_I Interim payment received by contractor at current period ($)

P_n Loan money drawn at period n ($)

$P_{n\,I}$ Loan money to be repaid at period n ($)

P_O Original remaining project duration prior to the payment disruption

P_R Percentage increase in remaining project duration (%)

W_O Activity weight at period i;

$m \leq i \leq n$ = m is the period of coincidence of the maximum value and n is the project completion date.

CHAPTER 1

INTRODUCTION

Construction projects tend to exhibit a unique trend in terms of their life cycle, from construction to demolition. Various research has been conducted to study different aspects of construction projects throughout their different life stages.

The research work for this thesis concentrates on the pre-construction stage of construction projects, namely the bidding phase. The reason for concern at this stage is that the project deals at large with forecasting, speculation and personal experiences. Decisions made during this phase are mainly judgemental and hence are not accurate, therefore they tend to exhibit some degree of discrepancy under actual circumstances. Due to economical circumstances, owners normally face lack of cash availability causing disruptions in the payments to their contractors. The research work concentrates on identifying a potential disruption to the contractor's interim payments by the owner and quantifying the consequences associated with it. This disruption is converted to a percentage, in terms of cost, that would be interpreted as an allowance factor. The contractor has two alternatives, either to add the allowance factor directly within his/her estimate, or to include it as part of a claims resolution plan which supplements the bid to the owner. This allowance factor considers the effect of payment disruptions on the project's cash flow and work schedule, specifically by quantifying the added financing costs and the impact costs associated with progress rates for the project.

The methodology of deriving the allowance factor is explained in Chapter 4. Prior to any derivations or reasoning, information was collected on previous works. Four case studies were obtained from construction managers, independent contractors particularly where the owners had disrupted contractor's interim payments at different intervals throughout the construction phase of the project. This procedure was necessary to quantify the consequences associated with the disruption and its effect on the project's cash flow and work schedule. Sixty cases were developed by accustoming the original four cases obtained to include the necessary variables needed for the quantification and validation of the developed model. As part of a system to validate the model, a hypothetical case adopted from literature was modified according to the original cases and has been included in the thesis for demonstration purposes.

1.1. LITERATURE REVIEW

This section was compiled by subdividing the relevant literature into several sections.

1.1.1. DEVELOPMENT OF BIDDING STRATEGIES

The bidding phase of a construction project is an important stage. Decisions made at this stage effect the project performance throughout its life. The uncertainties and changes that competitive and economic markets experience have caused different bidding strategies to evolve.

Following the pioneering work of Friedman in 1956, within the field of bidding strategies, Gates (1967) proposed basic rules regarding the same field. Gates defined several methods to be adopted by contractors under various scenarios. The main concept that Gates presented was the expectation value of the profit, to be included in a bid price, which was the most important factor in the contractor's bidding strategy. However, determining an ideal expectation value was not a straight forward process as it played the role of optimising both profit and risk simultaneously based on speculative deductions. He determined the expected value of the profit using various probabilistic and statistical theories.

Shaffer et al (1971) have approached competitive bidding strategies initially by investigating the work of the pioneers in this field. They concluded that all of the existing work could be characterised by one probability formula, furthermore, they validated various methods by applying actual cases to probability distributions and thus defined the ranges of acceptability.

Carr (1982) defined a contractors bid for a project as a function of the ratio of the firm's bid to its estimated cost for the project. This was deduced using random variables distributed about the average bid for the project by other contractors.

Ahmad et al (1987) and Shash (1993) attempted to answer the question of: *How are bid decisions made?* The work of Freidman (1956) and Gates (1967) attempted to do so,

however, they included many different variables and assumptions. Ahmad et al performed their study by administering a questionnaire survey among the top 400 U.S. general contractors which concentrated on two sets of criteria, each consisting of several factors to be ranked accordingly. The first criteria being bid/no bid decisions and the second criteria being percent mark-up decisions. Their results indicate that the common assumptions made by researchers towards competition and profitability, were not the only influencing factors in determining the bidding decisions. Shash (1993) performed a similar study except that it was directed towards the top 300 UK contractors.

Skitmore (1990) analyzed the standard bidding theories indicating that they concentrated on maximising profits which were represented by the mark-up value. However, he presented a multivariate approach which then adopted extensive mathematical calculus and probabilistic functions to determine the optimum profitability outcome and the most strategic mark-up value.

Moselhi et al (1993) proposed a simple methodology for contractors to select a project under risk. The system considers the uncertainties associated with each individual objective. Their system utilised the theory similar to that of the Programme Evaluation and Review Technique (PERT) system to deal with uncertainties.

1.1.2. IDENTIFICATION OF RISKS ASSOCIATED WITH PROJECT MANAGEMENT

Bowers (1988) discussed the importance of project risk analyses as a management aid in the planning and control of various projects. He described a software tool development, RISKNET, which combined network analysis with simulation techniques to analyze the timescale and financial risks. It performs the analysis by allowing the uncertainties of each individual project to be highlighted at an early stage, then interprets them by using a variety of probability distributions.

Al-Bahar et al (1990) have introduced another risk model, CRMS (Construction Risk Management System). The model allowed contractors to identify, analyze and manage the risks of a construction project in a logical and systematic method. The identified risks were evaluated by utilizing probabilistic analyses. The main advantage that this model has over others is that within the analysis and management processes, a potential impact or a consequential evaluation was performed.

Yeo (1990) defined cost overruns as a risk factor that may have been incurred in a construction project. Reference to common practice, a contingency factor needs to be allocated in order to *cushion* such risks. Yeo proposed an enhanced contingency estimating system depending mainly on the theories of probability and ranges which were the basis of the PERT system. Yeo (p.470) defined it as a "pseudoprobabilistic estimating system".

Gibson (1991) identified that risk involved the management of uncertainty. Gibson compared the traditional methods of risk management and then proposed a system which determined the contract sum and duration based on uncertainties. The methodology comprised of range determining a range estimate for the durations (similar to the PERT system) along with random value simulations to produce discrete frequency distributions for the project cost and time.

Neufville et al (1991), based on bidding simulations defined a relationship between the need-for-work and risk premiums for a contractor. They proposed that these two factors were independent yet additive. With a high level of confidence, they determined that the factors increased the bid estimate of the project by about 3%.

Ruskin et al (1992) provided an overall outlook on project risk management. They concluded that project risk management was performed according to the context of each individual project. Ruskin et al specified that with the existence of extensive statistical data the theories of probability can be used to define the risk involved. However, the risk assessment could be performed by the use of a formula based on the principles of ranges (PERT) had these statistical data not existed.

McKim (1992) once again defined the basic rules of risk management and expressed the options that contractors had to assess and counteract the risks involved within a project.

To accommodate the factors affecting the risk within the context of this research, two interrelated items need to be considered: the contractor's cash flow and project's work schedule.

1.1.3. RISK IN TERMS OF CASH FLOWS

In the case of cash flows, Kenley et al (1989) proposed a net cash flow model for a construction project based on logit transformations. These models enabled contractors to establish standards for working capital management and the comparison between project performance and standards. The authors also expressed the unlikely existence of a straight line net cash flow. This was mainly due to the initial expenditures incurred in a project.

Singh (1989) performed sensitivity analyses on various variables to determine the extent of their effects on the cash flows and the cost of overdrafts. Singh's findings suggested that emphasis had to be made in determining the most favourable credit conditions, because the frequency of payments (ie. credit conditions) had a substantial effect on the maximum cash requirement and in turn the cost of overdrafts.

Kaka et al (1991a) developed a net cash flow model to assist contractors in forecasting their cash flows at the bidding stage. For accuracy purposes, the cost schedules were utilised. However, after investigations and analyses, they indicated that producing an ideal net cash flow was not possible. On the other hand, the net cash flow model proved

to be an effective cash flow forecasting tool with respect to forecasting during the bidding stage.

1.1.4. RISK IN TERMS OF WORK SCHEDULES

With respect to work schedules, however, Parkinson (1980) and Hamburger (1987) identified the importance of having a realistic completion date with respect to a project. The concept of *wishing* that completion occurred under unrealistic situations was very critical. Therefore, Hamburger (1987) introduced guidelines to the concepts of schedule compressions and contingency allocations which accommodated such situations.

1.1.5. ESSENTIALS OF PAYMENT TIMINGS

Selinger (1983) identified that the payment timings were crucial, as this allowed contractors to evaluate the cost of the project on definite terms as well as to construct a cash flow forecast for the bid.

Westeinde (1988) examined the subcontractor payment clauses of the Canadian Construction Association Subcontractor forms and realised that the contractor was liable to pay the subcontractor whether payment from the owner had been received or not. Thus, the contractor had to take the entire financial burden for improvements to the owner's project when the owner delayed or failed to pay. Westeinde (1988) suggested that as the contractor tended to bear both the subcontractor's and his own losses, the financial risk had to be shared by both parties in accordance with their involvement in the

project. He suggested that this might be achieved by including amendments to the payment clauses.

Funduk (1988) demonstrated in a court ruling at the Court of Queen's Bench of Alberta, that contractors and subcontractors had to realise the importance of wording in contract clauses of the 'terms of payments'. Funduk suggested that a contractor could eliminate any liability of paying subcontractors on time due to the owner's disagreement of approving payment to the subcontractors by including a clause allowing the contractor to hold the subcontractor's payment unless the owner agreed to pay the contractor for the subcontractor's work. Thus, any further cash flow problems would be avoided.

Schleifer (1990) identified that the problem of delays in owner payments were due mainly to the common practice that existed in the construction industry: provide first, receive later. As a result, contractors suffered from disruptions in their cash flows and in turn faced increased costs. Schleifer suggested guidelines of remedying the problems. First, the contractor had to invoice on time and accurately. Secondly, the contractor had to establish good credibility and a standard procedural routine with the architect/owner at a very early stage in the project.

The main theme of this research is to determine the consequences that a contractor would face should the owner disrupt any interim payments. Hence, payment timings are an essential factor that need to be considered.

1.1.6. PAYMENT TIMINGS AND WORK PROGRESS

In order to investigate further problems that arise from disrupted interim payments, the relation of disrupted payments with work progress had to be established. Existing literature does not show any study involved in defining such a relation. However, in real life a relationship between project value and duration does exist. The derivations associated with this research work are based on the existence of such a relation.

Cusack (1985) identified the difficulty that existed in relating cost to time. The theoretical models that existed tended to be based on complex integer linear programming. However. when these principles were applied to a construction project certain drawbacks resulted. These included the need for highly qualified users to analyze the required data; the need for highly powered mainframe computing facilities; and the unreliability of the results. These were primarily due to the existence of several variables. It must be noted that Cusack highlighted the lack of desire that professionals within this industry have towards complex and over sophisticated mathematical solutions. He therefore stated that "it seems logical to look for a less complex solution" (p.184).

Kaka et al (1991b) specified that a strong relationship existed between the cost and duration of construction projects. They derived a model to incorporate this relation in the contractors budgeting system.

1.1.7. CONTRACTOR'S RESPONSE TO UNCERTAINTIES

Human nature most often calls for security action or counteraction to be taken in the case where doubt can be found. Therefore, contractors realizing the possible side effects of their interim payments being disrupted by the owner, it was natural that the potential uncertainties were to be counteracted by manipulating the mark-up of the bid by utilising risk or contingency factors. However, one thing that most researchers demonstrated was the adoption of probabilistic and statistical theories as demonstrated below.

Gates (1971), Kerridge (1986), Carr (1987), Yeo (1990), Skitmore (1990) and Ahmad et al (1987) have all attempted to quantify the optimum mark-up value that had to be used by applying various probabilistic theories.

The use of probabilistic theories by various authors tend to exhibit several drawbacks because they are based on personal experience, historical data and random number generations. This demonstrates the possibility of inaccuracies due to the speculative nature of the system as well as the complexity involved in allocating the appropriate probability percentages for the system.

Due to the increasing number of variables that exist in the construction industry, the level of uncertainty and the involvement of risk management are escalating.

Bowers (1988) and Gibson (1991) both emphasised the importance of project risk analysis with regard to the potential effects of the uncertainties rather than the ascertained certainties.

Hamburger (1987) identified the theoretical and methodological procedures that contractors may adopt to account for work schedule uncertainties. However, on a more extensive level, Hamburger (1989) introduced the concept of contingency planning with specific regard to both budget and schedule contingencies.

Sey et al (1990) performed a study on the factors that affected the contractor's bid price. The most essential finding was that the factor 'payment conditions' relating to finance was ranked number one among the 37 defined factors.

Once contractors realised the importance of considering uncertainties, the decision had to be made on the factors which seemed to be of critical nature to the size of the mark-up.

Carr (1982) deduced that the contractor's expected value was not very sensitive to small variations in the mark-up value. His justification was that each mark-up adjustment was counterbalanced by the shift in the probability of winning.

Contrastly, Ahmad et al (1988) performed a survey with regard to the decision-making factors involved in the size of the mark-up, and deduced that the two main factors were

'degree of hazard' and 'degree of difficulty' of the project. Shash et al (1992) deduced that the factors 'availability of cash' and 'economic risk involvements' were highly ranked due to the widely spread economic downfalls (ie. the recession). In addition, Shash (1993) performed a similar survey to that performed by Ahmad et al (1988) with respect to the UK industry. It was deduced that the two main factors where 'degree of difficulty' and 'risk involved owing to the nature of the work'.

As mark-up estimating becomes more of an essential development, Ahmad et al (1987) and Tavakoli et al (1989) proposed the use of knowledge-based expert systems that performed the duties of determining the mark-up value to be implemented within a contractor's bid estimate.

1.2. FINDINGS BASED ON LITERATURE REVIEW

Based on the results of the research performed by the above mentioned researchers, it can be stated that financial forecasting and payment control to contractors in the construction industry are rudimentary. Therefore, the findings have been divided into two categories: 'on-going' and 'unaccomplished'. The former deals with the identification of the current research practices and developed research dealing with this study, while the latter deals with factors that have not yet been addressed or developed within this field of study.

1.2.1. ON-GOING WORK

Initially, in terms of bidding strategies and the identification and quantification of uncertainties, it is obvious that for the past three decades identification of an ideal solution has been the concern of researchers in this field, namely Friedman (1956), Gates (1967), Car (1982) and Skitmore (1990). Also, they have targeted the problem through the manipulation of risk and contingency factors to be implemented into the bid mark-up. Tackling this hurdle is an ongoing complexity due to the increasing number of variables that develop within the construction industry in terms of new construction methods and managerial hybrids. The typical approach adopted by these researchers was the use of random variable simulations by applying the Programme Evaluation and Review Technique (PERT) system, as well as probabilistic and statistical theories. Several drawbacks arise from the use of each of these principles. In the former system (PERT), the contractor imposes variations with regard to the accuracy of the optimistic, most likely and pessimistic values of each application. These are judged purely by personal experience and historical data. In addition, the skewness of the typical beta curve used in the PERT system may impose a certain degree of variance. In the case of probabilistic theories, they are based once again on personal experience, historical data and random number generations. As a result, a certain factor of uncertainty tends to exist at the initial stage which may reflect throughout the project.

Based on these deductions, various work which has not been explored by others is highlighted in the following section which will serve as guidelines to the establishment of the research objectives.

1.2.2. UNACCOMPLISHED WORK

As a result of the above mentioned findings, it can be stated that there is no systematic/non-probabilistic approach available on the market to target the identification and quantification of uncertainties other than the standard approach of using the mark-up systems.

In addition, several authors ((Selinger (1983), Westeinde (1988), Funduk (1988) and Schleifer (1990)) have performed studies indicating the importance of payment timings with respect to both contractors and subcontractors. However, there has been no work done with respect to the identification of the consequences with regard to disruptions in the payments and a relationship has not been identified with respect to disrupted interim payments and work progress.

1.3. RESEARCH OBJECTIVES

Based on the review of literature on research work and studies of current construction practices, the objectives of this research work are as follows:

1. Determine the consequences of disruptions in the contractor's interim payments by the owner on the contractor's cash flow and project's work schedule;
2. Develop a mathematical model to systematically analyze and quantify the consequences caused by the disruptions in payments;
3. Express the quantified consequences in terms of an allowance, as a percentage, within the contractor's bid estimate.

1.4. DATA COLLECTION

Data collection process is an important key in developing any model. It requires the researcher to be familiar with the problem domain. In this work, in addition to the researcher's background in both construction management and construction engineering, an extensive literature review was conducted to obtain an overview of the problem. It is equally important to identify the experts, whose knowledge is going to be captured and implemented in the derivation of the system. In this research work, the knowledge for the system was derived from self experience, experts in the domain of construction management, construction financing and construction engineering, published literature and study of actual cases. The interviews were conducted after visiting three construction management consultants, three independent contractors and two major banks. Lengthy consultations with individuals within these organisations were held. The interviews were usually with one practitioner at a time which lasted approximately 2 hours. All interviews were conducted over the course of developing the model. Structured interviews and prototyping techniques were used during the interview sessions.

Structured Interviews: Experts were asked to describe all their knowledge of current techniques adopted in dealing with payment disruptions which occur throughout the project and the parameters involved in obtaining financing for the project. An actual case from their previous work was discussed.

Prototyping Techniques: This involved the development of a preliminary methodological model, incorporated within spreadsheets for 15 case studies (based on four original cases) at an early stage during data collection. The prototypes were offered for criticism and gradually improved by asking the practitioners to comment. Also, the demonstration of the prototype proved very valuable in revealing new knowledge. The procedure was repeated until the final stage of the system was approved by the experts. The designing process was based on the capability of the system to integrate with software for scheduling that already exists in the construction industry. Incorporating available tools helps avoid the negative momentum generally encountered with the introduction of new technologies, particular in a conservative industry such as construction.

INTERVIEW PROBLEMS: The following problems were encountered during the interview process:

1. The practitioners were not convinced that the consequences of payment disruptions that occurred during the construction stage could be quantified at the bidding stage. However, after a few sessions and especially when they were exposed to

the demonstration prototypes, they were convinced that these systems might be of benefit to the industry.

2. Contractors and bank officers are always sensitive when the matter is related to costs and financing and they treat this aspect with great confidentiality. Therefore, a problem of discussing detailed decision processes arose and in most cases the decision was accepted as is.

3. Contractors use their experiences and historical data to include a percentage allowance which would account for the possibility of any payment problems that may occur, thus making a typical remedial action difficult to identify.

MODEL IMPLEMENTATION: The model was developed in order to be used on IBM personal computers or compatibles which requires scheduling and spreadsheet softwares. The model is recommended for only small and medium sized projects, estimated under $10 million. Large projects tend to include differences such as different financing schemes, costing and management strategies.

1.5. METHODOLOGY

Sixty cases developed from changing different parameters for the 15 cases that were discussed with the practitioners, were used as simulators performed using two software packages: LOTUS 1-2-3 (Lotus) and PRIMAVERA (1991). The cases were scheduled using PRIMAVERA's scheduling package. Once schedules were performed, a cost and cash flow breakdown was established for each case. Thereafter, the cash flows were

disrupted for one and two consecutive periods throughout the project. The overall effect was then determined in monetary and duration terms. After validating this methodology using the sixty cases, based on the same principles, the quantification methods were then interpreted in mathematical terms to develop the required model.

1.6. THESIS OUTLINE

This thesis has been presented in a systematic way.

CHAPTER 2 : Highlights and presents the bidding process.

CHAPTER 3 : Discusses in general terms, the techniques available to contractors to analyze construction delays.

CHAPTER 4 : Identifies the consequences associated with disruptions in payments. It also presents a mathematical model to quantify the allowance factor with regard to payment disruptions.

CHAPTER 5 : Deals with model validation and demonstration using a hypothetical case study.

CHAPTER 6 : Presents the conclusions of this research along with the contributions to the field of uncertainties in forecasting. Also, recommendations for future research are included.

CHAPTER 2

THE BIDDING PROCESS

Competitive bidding is the most common method of acquiring tendered construction projects. This procedure is normally at the first stage of awarding a project contract. Under the traditional format and procedures the bidding documents consisting of specifications, quantities and drawings are prepared by the owner's professional staff or advisors and sent to various qualified contractors inviting them to bid on the project. The choice of invited contractors is performed by one of two formats: open or nominated lists of competent contractors. In the case of an open list, any contractor capable of performing the job within the required duration and specifications is invited to bid. While reviewing the submitted bids the owner normally, but not necessarily, awards the project to the lowest bidder. The owner reviews the contractors' bids under four main categories: time, cost, quality and safety (Rankin et al, 1993). However, in the case of the nominated list of contractors normally the three lowest bidders would be selected as part of a short list. Thereafter, the owner shall negotiate the prices with the contractors on the short list. Once the prices have been agreed upon and the conditions of contract set with one of the contractors, the contract is then awarded.

During the bidding stage, the contractor needs to decide whether to bid or not to bid. Several authors have performed studies with regard to this decision (Ahmad et al, 1988; Shash, 1993). One of the most coherent studies was performed by Ahmad et al (1988)

which consisted of a questionnaire survey among the top 400 U.S. general contractors to determine the factors that affected the bid/no-bid decision of contractors. The two top ranked factors were 'type of job' and 'need-for-work' among the 31 listed factors. In a similar study, Shash (1993) applied the same concepts to the top 300 UK contractors and realized that the results were fairly compatible with those of the previous study. The two top ranked factors where 'need-for-work' and 'number of competitors tendering' among the 55 listed factors.

Generally, after having decided to bid, it can be said that the contractor with the lowest bid price is the most likely to be awarded the job. The direct cost estimates of each contractor should be approximately around the same range which is due to the similar methods and aids that contractors would implement to quantify these factors of direct labour, direct material, subcontractors, facilities and equipment and engineering costs. The quantification means of the direct costs are based on standard unit costing references, historical data and personal expertise. However, in real life this is not the same because of labour productivity variations.

Once direct costs have been quantified, indirect costs have to be determined. Indirect costs are not as definitive as direct costs. They can be subdivided into two categories: variable and fixed overhead costs.

Variable overhead costs are costs that do not vary with the output levels but are affected by time. These costs can be further divided in to two categories: field/site and special overheads. The former includes the project manager, superintendent and office staff wages and costs, while the latter includes items that are related to the special conditions in the contract and specifications, such as safety items, change orders, licenses and permits. Most importantly, it includes an allowance factor which safeguards the contractor against any unforseen incidents. This is not a definitive item, it depends mainly on the contractor's experience with the owner, previous work on similar projects and forecasting capabilities.

On the other hand, in the case of fixed overhead costs, they are costs which do not vary with output and remain to be borne even when output is non-existent. They are included only once in cost estimates (ie. non-recurring). As a result, no matter what delays occur, these costs remain consistent or fixed and a party will have no grounds when trying to claim on non-recurring indirect costs.

Under construction projects, fixed overheads are also known as Head Office overheads. Considering this overhead in greater depth, it consists of four main components: Main Office costs (such as legal staff, estimators and accountants costs); Insurance (such as builder's risk, contractual liability and theft); Bonds (such as bid and performance bonds) and Interest. The interest portion of the Head Office overhead denotes the cost of borrowing money. It is common practice that contractors within the construction industry

finance their projects by taking out loans or by obtaining a line of credit from banks or other financial institutions. The cost of such a procedure is interpreted in terms of interest to be paid by the contractor. The interest rate paid depends on various factors including the credibility of the contractor and the owner, the economic situation, the type of project, the duration of the project and the size of the loan requested. The interest to be applied as part of the Head Office overhead value is therefore fairly accurate. Yates (1990) performed a study on various financing schemes that are available for projects in international engineering and construction markets. Yates identified several of the innovative financing schemes that are available on the market such as countertrade; World Bank co-financing; swap financing and nonrecourse project financing. These schemes have emerged in the industry during the last decade. By adopting these innovative techniques, companies were capable of undertaking projects that would have otherwise been impossible or difficult to attain using the traditional financing techniques. Yates then recommended that in order for engineering and construction companies to maintain their competitive status, they constantly had to amend their financing styles to suit their environment.

Certain Head Office overheads (typically Main Office overheads) may be difficult to quantify in a precise and individual manner as they are portioned relative to the number of projects in hand.

At this stage, the above two factors of direct and indirect costs may be combined to establish the ***project cost estimate*** in monetary terms.

The profit portion to be added to the project cost estimate, on the other hand, is determined by the higher management as it depends on various factors such as the company's competitive strategies, the required returns, the need-for-work, the economic situation of the company and the possibility of future work with that owner. Once the required profit percentage has been determined, the mark-up is established and the bid price for the project is completed.

This mark-up value, that contractors include in their bid price causes the differentials within the contractors' bid prices. Therefore, the mark-up value is the critical factor that needs to be considered by each contractor as it reflects the chances of winning the bid. The subject of mark-up has attracted the attention of several researchers since the mid 1950's when Friedman initiated his work in 1956 and thereafter Gates in 1967. Since then, many other researchers have contributed to the basic theories attempting to derive a figure which represents an optimum mark-up. This optimum figure reflects on the maximisation of profit and on contingency factors that are included in order to account for uncertainties which may arise during the construction phase. The most common approach to such derivations have been the use of probabilistic models and statistical theories such as the works of Shaffer et al (1971), Carr (1982), Ahmad et al (1987) and Skitmore (1990).

In addition, Sey et al (1990) presented a list of 37 factors that affected the bid price of contractors along with their order of importance amongst 34 contractors. The results indicated that 'payment conditions' was the factor that affected the bid price most. This list has been used to complement the factors indicated within this research.

It must be noted that with the existence of difficult economic conditions, contractors' need-for-work is high and therefore the problem of low cost estimates to establish a low bid price to win the project is common. However, the contractors resort to claims in order to compensate for the intentionally under estimated or applied costs and profit respectively.

Due to these potential problems, owners tend to evaluate contractors' qualifications based on certain guidelines other than their financial status. Items such as the contractor's past and present performance on various projects and their experience within the industry (Russell, 1990) are carefully considered. Rankin et al (1993) indicated that the General Services Administration (GSA) in the US have implemented a system called "Competitive Negotiation and Technical Merit" (p.206) which includes the price factor as just one of the considered factors.

Once the bid price is established, a detailed revision is performed to ensure the accuracy of the estimates. Then the bid is submitted within the specified deadline period.

The owner and the professional advisors open and review all the submitted bids. The review will occur according to an agreed set of guidelines that are normally determined at the discretion of the owners themselves and their policies.

As mentioned earlier, depending on the format of bidding adopted (ie. open or nominated lists of contractors), the owner shall award the bid to the successful contractor, whereafter the construction stage shall commence.

This chapter identified the traditional system adopted within the construction industry in obtaining contracts under the system of competitive bidding. It can be deduced that bid prices submitted by contractors tend to vary amongst others and therefore, indicating that the existence of uncertainties is unavoidable. The following chapters explain a methodology by which contractors may present a more attractive bid to the owner by demonstrating their competence and by accounting for potential mishaps that may occur throughout the construction stages of the project as part of their cost estimating techniques and strategies.

CHAPTER 3

CONSTRUCTION DELAYS

Delays in the construction industry are inherent, yet unavoidable events which can result from incidents such as poor organisation, variation orders, strikes and material shortages. Extensive research has been published in this field by several authors (Kraiem et al, 1987; Leary et al, 1988; Reams, 1990; Alkass et al, 1991; Mazerolle, 1993).

Another important cause of construction delays is interim payment disruptions by the owners to their contractors (Awad et al, 1992, 1993), although this type of delay has not yet been implemented into existing delay analysis techniques available to contractors. When delays occur during the construction life of the project, they are analyzed in terms of monetary and time extension compensations. The basis and techniques involved in performing such analyses are demonstrated in this chapter.

All the existing techniques available to contractors with regard to delay analysis can only be applied once the delay has occurred (or upon project completion). However, Chapter 4 proposes a methodological model which accounts for delays caused particularly by interim payments to the contractor by the owner. The model is unique because it accounts for the delay at the forecasting/bidding stage of the project. As a result, contractors may be able to secure their project work schedule from being affected at a later date.

With regard to current practices, delays have been classified into two categories: excusable and nonexcusable delays (Kraiem et al, 1987; Leary et al, 1988; Reams, 1990; Alkass et al, 1991; Mazerolle, 1993).

Excusable delays are not characterised as actions or inactions of the contractor, they are a cause of unforseen events. In other words, these are events beyond the contractor's control and are without fault or negligence. Once these delays have been identified, the contractor becomes entitled to an extension in time if the completion date had been affected. Excusable delays can be further classified into compensable and non-compensable delays (Reams, 1989; 1990). Excusable compensable delays are delays resulting from the actions or inactions of the owner. Usually, the contractor is entitled to an extension in time as well as a monetary compensation associated with the delay. A typical situation reflecting such an event would be where the owner has not set-up scaffolding on time for the contractor to proceed with the required work. On the other hand, excusable non-compensable delays are delays where neither the owner nor the contractor is responsible for the delays. Typically, the contractor will only be granted a time extension when there are no grounds for damages, for example when a *Force Majeure* incident occurs.

The non-excusable category deals with delays caused by actions or inactions of the contractors or their subcontractors. As a result, the contractor has no grounds to claim for either a time extension or a monetary compensation. In fact, the opposite may be

true, the owner may be entitled to delay damages. An example of this situation is when the contractor fails to place a full crew on site to complete the required work.

Delays may occur concurrently regardless of their type. Concurrent delays consist of two or more delays occurring simultaneously or delays that overlap to some degree. However, even if these delays occurred separately, they would still affect the overall completion date (Rubin et al, 1983). Any concurrent delay involving an excusable delay normally results in an extension of time being granted to the contractor. However, when compensable and nonexcusable delays occur concurrently, either an extension of time can be issued or the overall delay will be distributed between the owner and contractor with respect to their liabilities.

Concurrent delay analysis involves the assessment of each delay separately in terms of their impacts on other activities and the project duration. Non-critical activities have to be considered in the analysis, specifically the floats. The reason for this is that non-critical activities may become critical due to the exhaustion of the floats by the delays.

Guidelines for classifying the concurrent delays have been presented by Rubin et al (1983) as follows:

a) Concurrent delays involving excusable and nonexcusable delays, where the contractor is only granted a time extension.

b) Concurrent delays involving excusable compensable and excusable noncompensable delays, where the contractor is only entitled to a time extension but not to a monetary compensation.

c) Concurrent delays involving two excusable compensable delays, where the contractor is entitled to both an extension in time and monetary compensation.

These guidelines may be useful for delay analysis, however, clear contractual definitions of the terminology is required to avoid further complications at a later date.

3.1. TOOLS FOR DELAY ANALYSIS

This section will highlight the type of schedules used to perform delay analysis and will explain the existing methods that are currently adopted to perform the analysis.

3.1.1. TYPES OF SCHEDULES

In order for contractors to analyze the consequences or impacts of the delays on the entire project, four main schedules are used: as-planned, adjusted as-planned, as-built and entitlement schedules (Mazerolle, 1993).

The as-planned schedule illustrates the contractor's original plan for performing the work. This schedule includes the critical path(s) along with the planned activities and their start and finish dates. However, it must be noted that this schedule does not present the work progress. Once delays or disruptions have occurred, the contractor would then reschedule

the as-planned schedule accordingly to develop an adjusted as-planned schedule. This would represent the adjusted critical path(s) along with adjusted start and finish dates of the planned activities. Upon completion of the project, the final adjusted as-planned schedule, which includes all the adjustments made throughout, is now known as the as-built schedule. Rather than showing the planned start and finish dates of the activities, the as-built indicates the actual start and finish dates of all the activities. Finally, once all the above schedules are in hand, the entitlement schedule can be established. This schedule indicates the actual completion dates with respect to the excusable delays throughout the project. The final entitlement schedules reflect the original, adjusted and actual completion dates which would then be used to establish the total time that the contractor would be entitled for compensation.

3.1.2. CURRENT PRACTICES USED FOR DELAY ANALYSIS

Various techniques have been developed, using the as-planned and as-built schedules to determine the consequences on the overall project's completion date. The techniques adopted for delay analysis in the construction industry are described below (Leary et al, 1988; Reams, 1990; Revay and Assoc.).

GLOBAL IMPACT TECHNIQUE

This is one of the simple approaches used to determine the impact of the delays on the project schedule. It is usually used by contractors to obtain a time extension, most often during the construction phase. Using this technique, the total delay (ie. the global impact)

is determined by summing all the delayed durations. The total delay is then plotted on a summary bar chart (Leary et al, 1988).

NET IMPACT TECHNIQUE

This technique attempts to deal with the consequences of concurrent delays. All the delays are considered, however, only the net impact of all the delays is represented on the bar chart. The contractor will then request an extension in time with respect to the difference between the as-planned and the as-built completion dates (Leary et al, 1988).

ADJUSTED AS-BUILT CPM TECHNIQUE

This technique utilizes the CPM system to establish an as-built schedule. The delays are characterised as activities which would then be inserted into the CPM, indicating their links with other activities. The critical path durations of the as-planned and the as-built schedules are compared. The difference is then used by the contractor as a basis for requesting compensation. This technique is similar to the net impact in the sense that it only identifies the net effect of the delays.

'BUT-FOR' TECHNIQUE

This technique utilises the CPM scheduling system. The contractor would identify all the delays he/she is responsible for and would then include them into the original as-planned schedule. The final completion date established is then compared to the as-built completion date. The difference is used as a basis for requesting compensation. The

main idea behind this technique is that, regardless of the delays resulting from the contractor, the project would still overrun the planned duration. This overrun becomes the responsibility of the owner.

SNAPSHOT TECHNIQUE

This technique differs from others in that it is used to determine the duration of the delay, time of occurrence and cause(s). By using as-planned, as-built and any updated schedules that might have been produced throughout the project, the total project duration is divided into a certain number of time periods that are known as snapshots.

By using the as-built schedule for the snapshot period under consideration, along with information deduced from the previous snapshots, an extended duratior schedule is generated. The generated project completion date is compared to the original date indicating the difference in the delay duration which has occurred. Once the delayed duration is established, the causes of the delays are determined. This is then repeated for each of the snapshot periods. The total delays are then accumulated to establish the overall delay duration which will then be apportioned between the contractor and the owner, depending on the liabilities deduced.

TIME IMPACT TECHNIQUE

This technique is similar to the snapshot technique, except that it concentrates on a specific delay rather than the time period containing the delays. The as-planned schedule

is then recalculated including the actual durations of the project to establish a completion date. Then, the delay is included into the schedule for recalculation of a new project completion date. By comparing the two completion dates, the difference indicates the effect of the delay on the work schedule. This technique is applied to each delay in a progressive manner. The individual time impacts are then accumulated to establish a total impact that the delays have imposed on the project's completion date. The total impact is then divided between the owner and the contractor with respect to their liabilities, which in turn provide the contractor with means to request for compensation.

3.2. SUMMARY

Construction delays tend to be an unavoidable occurrence during the implementation stages of construction projects. As a result, it has become a field of great interest for researchers.

This chapter highlights the existence of several techniques used by contractors within the industry to analyze the extent of delays that they encounter, which in turn are used as means for compensation (either monetary or time wise). Despite these advances, it can be seen that contractors have to deal with the consequences of the delay once they have occurred. For contractors involved at the bidding stages of projects, there is no direct technique or system which assists contractors in allowing (in specific terms) for such occurrences to be considered at the forecasting stages of the project.

The following chapters propose and validate a model which contractors may implement at the forecasting stage to account for a pre-determined delay which would occur at a later date during the construction phase of the project. Specifically, the damages inflicted on the contractor's cash flow and project work schedule due to payment disruptions by the owner will be addressed.

CHAPTER 4

QUALITATIVE AND QUANTITATIVE CONSEQUENCES OF DISRUPTIONS IN INTERIM PAYMENTS BY THE OWNER

4.1. INTRODUCTION

Gibson (1991) stated that construction projects were risk exercises which involved the management of uncertainty. Considering that, two related factors are exposed to the uncertainties of timely payments by the owner, namely the contractors' cash flows and project's work schedules. Cash flows are based on the work completed within a specified period and the work progress is related to the steady flow of interim payments by the owner. Therefore, any disruptions in interim payments would cause a shortfall in the contractor's cash availability. Accommodating this shortfall requires the need for extra working capital to be raised in order to avoid delays in the work schedule (Awad et al, 1992; 1993). This potential problem further complicates the construction financing procedures and makes it more difficult to secure funds for the project.

Taking the above relationships into consideration, along with the typical practice in the industry of providing first and receiving later, the contractor is faced with further problems in terms of the project's cash flow and work schedule. To account for these problems, the contractor has the option of choosing between three remedial actions. First, the contractor will attempt to locate extra funds to compensate for the shortfall in the available cash. These compensable funds will cost the contractor extra interest which

might have not been accounted for within the bid price estimate. Secondly, the contractor will slack behind in the work schedule indicating a reduction in the work's progress rate. Some of the reasons which account for this are the psychological demotivation of the labour due to disrupted wages; cut backs in crew sizes and material supplies; and delays in providing workshop drawings to the subcontractors. Finally, the contractor may resort to the most severe scenario: stopping the work completely for the period of payment disruption. Lack of funds or pressure tactics to make the owner process the payment promptly result in such stoppages. However, this last option is not favourable to the contractor. Adopting this option may place the contractor's reputation in jeopardy as well as reduce his/her chances of obtaining future work with the same owner. Consequently, this scenario may be viewed as the most pessimistic consequence of disruptions in the contractor's interim payments. Identifying and quantifying its effect on the project cash flow and work schedule is straight forward. The period of work stoppage is directly reflected as an extension on the critical path duration, as a result this consequence can be quantified directly.

With respect to the above interpretations, the main consequences of the disruptions in contractor's interim payments by the owner are (Awad et al, 1993):

1) Added Financing Costs, and

2) Reduction in Progress Rate.

The remaining part of this chapter identifies the qualitative theories and quantitative methods used for each of the above consequences.

4.2. IDENTIFICATION OF METHODOLOGY PATH

Figure 4.1 illustrates the typical routines that occur at the pre-construction stage of a project. The contractor's preparation of the project cost estimate prior to submitting the bid is the concerning activity for the purpose of this research. Focusing further on this item, Figure 4.2 shows the various activities that occur during the contractor's project estimation stage. Once the contractor has decided to bid in accordance with the issues stated in Chapter 2, the respective activities would then be carried out. Prior to submitting the bid, the estimator's report is sent to higher levels of management in order to determine a markup figure for the project. Figures 4.3 and 4.4 illustrate the factors involved in determining the bid price for a project. However, this work concentrates on identifying the amount of security that the contractor needs to consider as an allowance factor, in percentage terms, for increased financing costs and reduction in the progress rate which would arise because of the disruption in interim payments to the contractor by the owner.

The allowance factor is part of the item named *specials* within the contractor's variable overheads (as indicated in Chapter 2), which also, is part of the contractor's indirect costs.

Figure 4.1 - PRE-CONSTRUCTION FLOW CHART

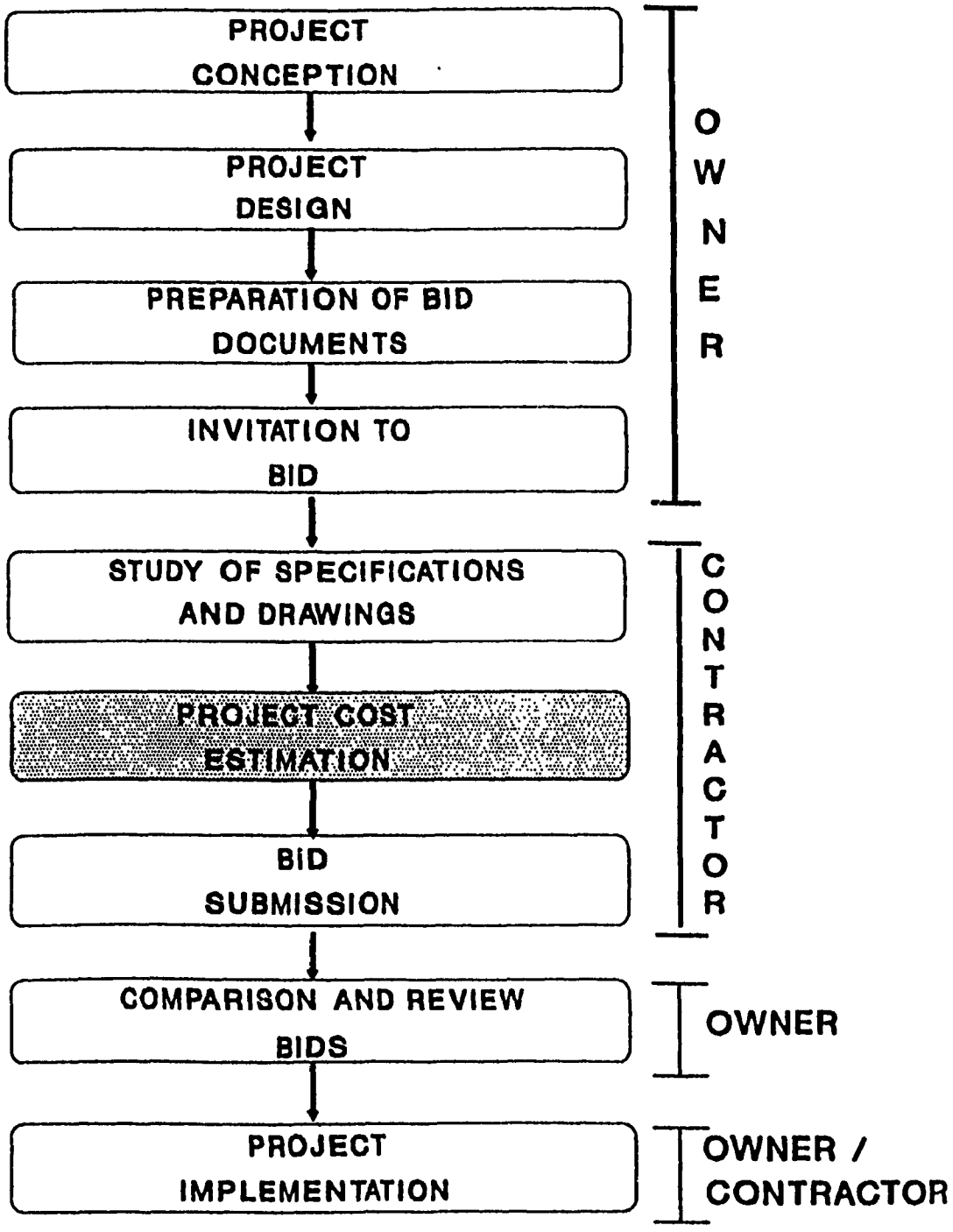


Figure 4.2 - PROJECT ESTIMATION

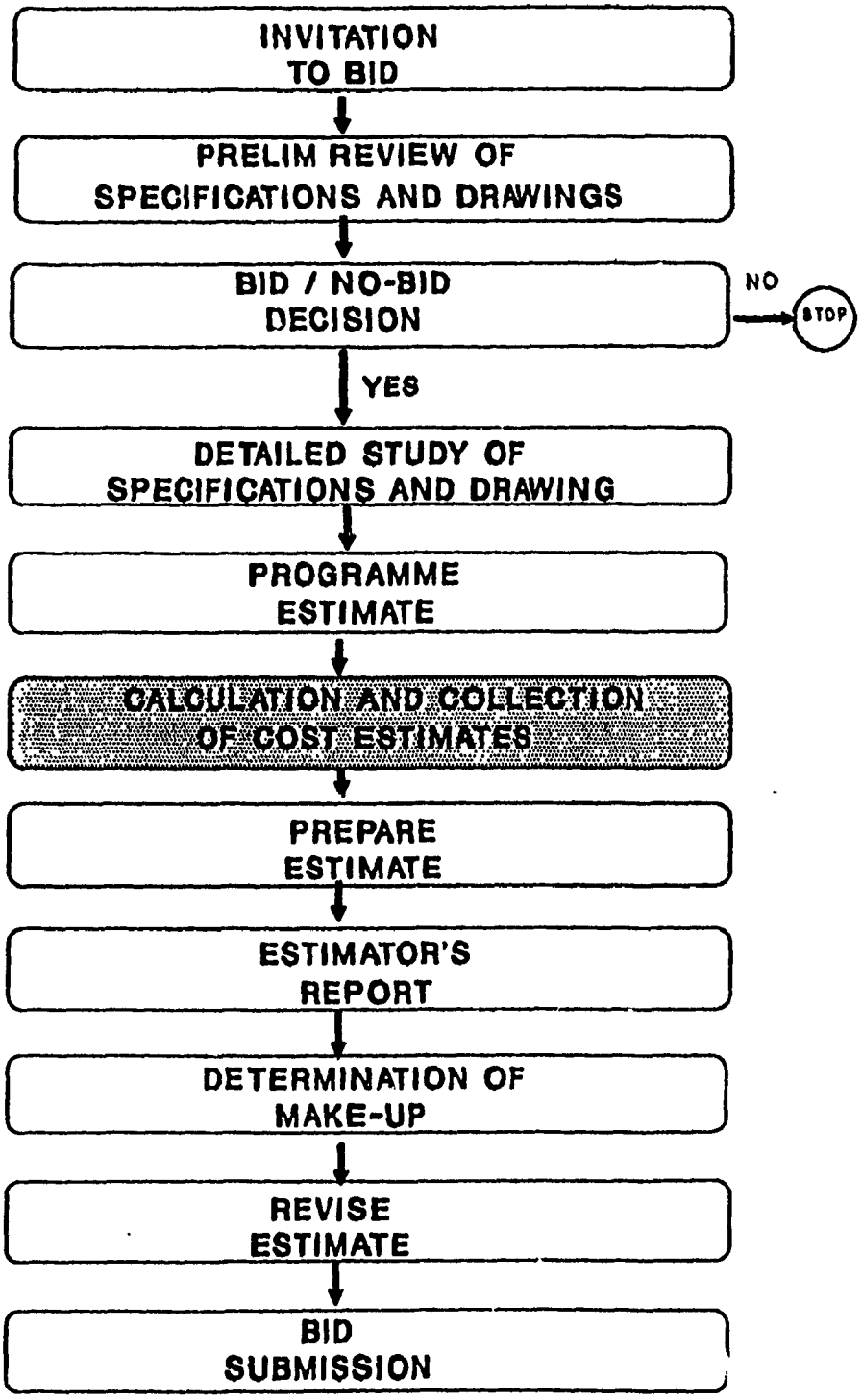


Figure 4.3 - COST FACTORS IN BID PRICE (Halpin, 1985)

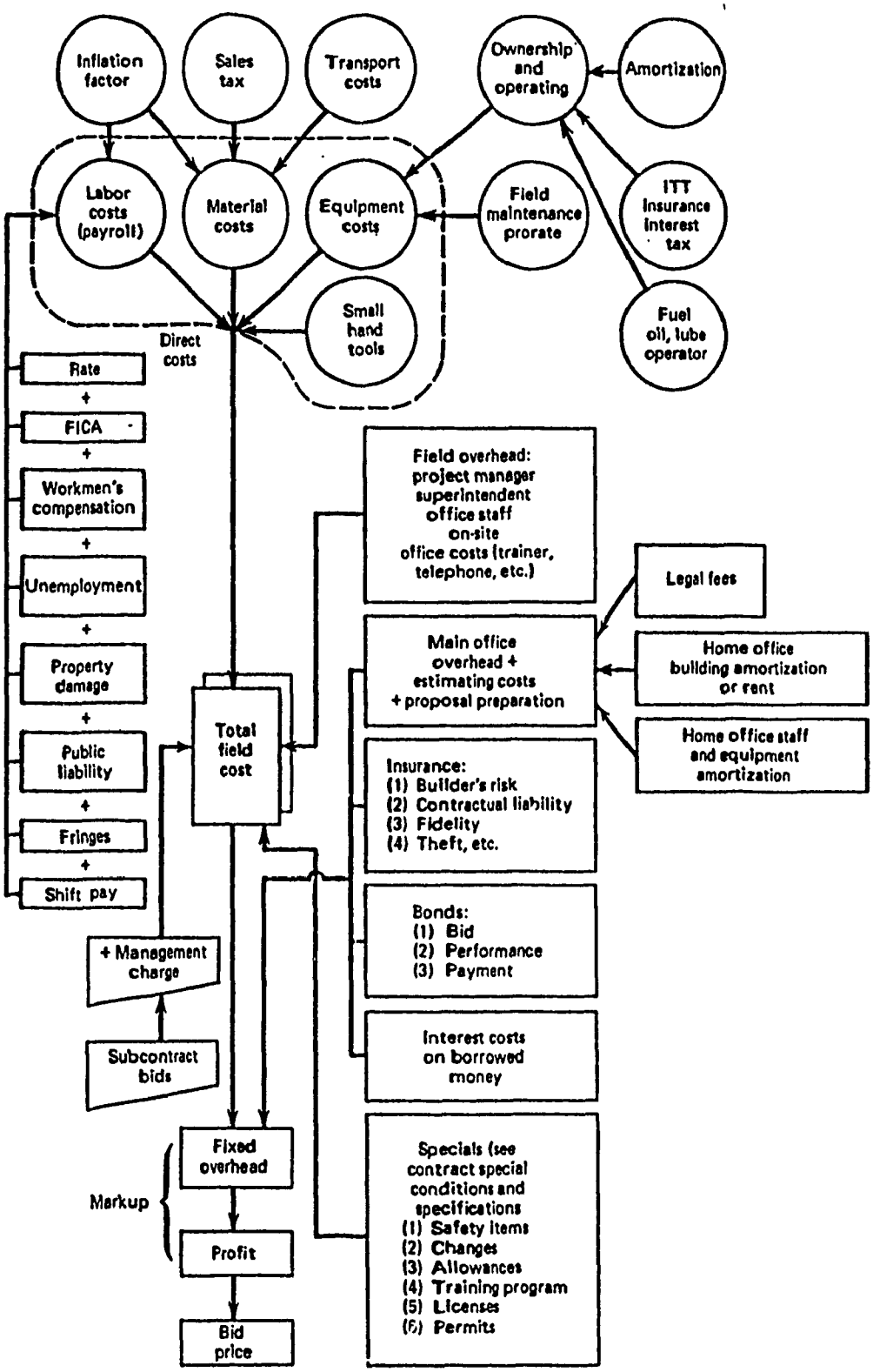
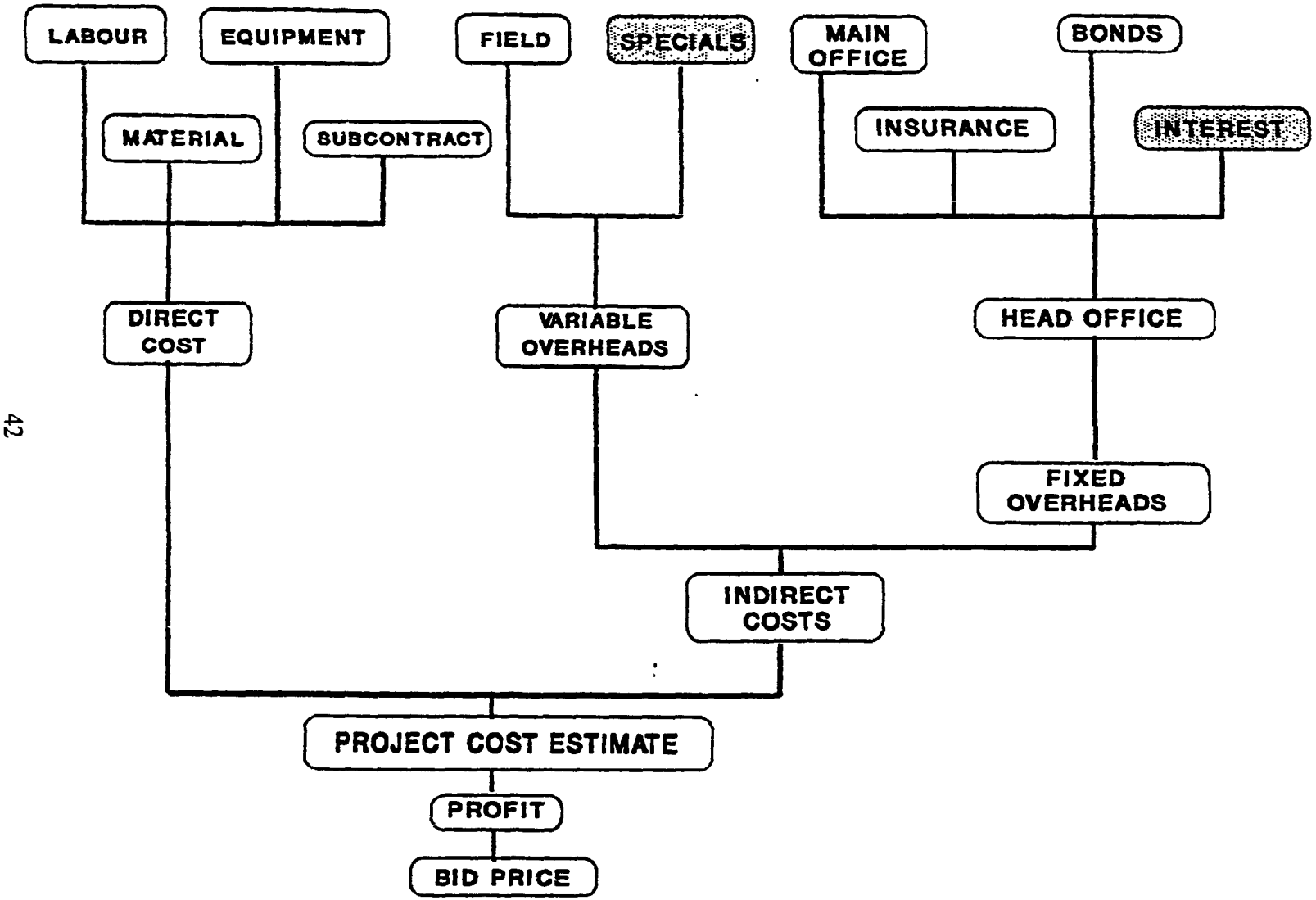


Figure 4.4 - SUMMARY OF FACTORS INCLUDED IN BID PRICE



The allowance factor is then determined in terms of ***added financing costs*** (Section 4.3) and ***impact costs*** with respect to the reduction in progress rate (Section 4.4).

4.3. ADDED FINANCING COSTS

Referring to Section 4.1 above, one of the remedial actions taken by contractors to counteract or offset the problems of disrupted interim payments by the owner is to locate extra funds to compensate for the shortfall in the available cash. As a result, the contractor is faced with extra interest costs to account for the increased funds needed for the compensation of the shortfall. This increased cost is not usually accounted for within the bid price estimate, therefore, these additions reflect the increases in the financing costs to the contractor.

4.3.1. QUALITATIVE THEORY

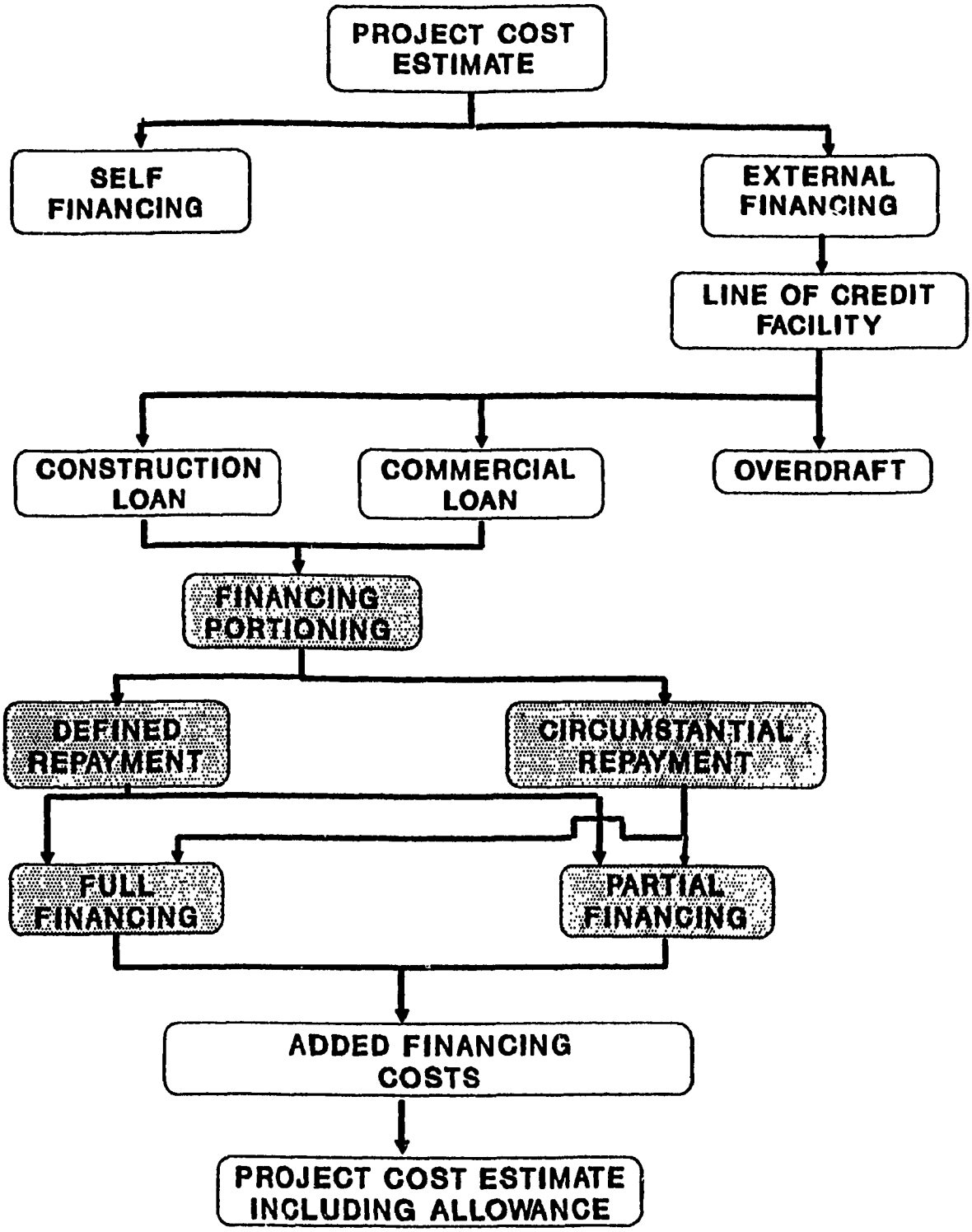
This section explains the typical decisions that contractors usually make in accordance with the options available to them (Figure 4.5) to determine the added estimated costs that will result depending on the financing scheme available to them. The flow chart in Figure 4.5 was derived as part of the research, based on comments and information demonstrating the industry's current practice, which were obtained from meetings and interviews set with two of the major Canadian banks, a construction management consultant and independent contractors.

Once determining the ***project cost estimate***, the contractor will decide whether to adopt a self or an external financing scheme. Due to the current trend in today's industry, the adoption of ***external financing*** has been assumed for the purpose of this study. External financing requires the allocation of a ***line of credit*** facility by a financial institution. A line of credit was defined as a "commitment by a financial intermediary to stand ready to lend up to a specified amount to a customer on request" (Binhammer, 1988; p.666).

In reference to the meetings held with the officers from two major banks, it was deduced that the common financing systems made available to contractors within the Canadian construction industry were construction loans, commercial loans and overdrafts. Construction loans, also known as term loans, may be obtained by either owner/developer or contractor for a specified period. However, the owner usually obtains it at a lower interest rate. The intention of this money is to cover the contractors' bills and payroll during the construction phase of a project. However, the main catch is that the lending institutions prefer that a permanent loan (such as a mortgage facility) be in the hands of the borrower (Halperin, 1984; Cooke et al, 1986). Consequently, both the mortgage money and the constructed facility are used by the bank as security should the borrower default on the loan repayment schedule.

The commercial loan is very similar to the construction loan except that the loan is drawn with a commercial bank and is considered as a short-term business loan, usually for a period between 90 days and 3 years. It is defined as a business loan because its main

Figure 4.5 - FINANCING ROUTINE



purpose is to allow the business to operate and make a profit (Halperin, 1984). As the commercial banks are not interested in getting involved in real estate affairs for the purpose of security provisions they tend to increase the interest rate at which the loan is granted for that purpose.

Finally, an overdraft facility is an option which contractors may consider in complementing their financing scheme. However, the main purpose of an overdraft is to finance the contractor's receivables which would be due within a short period of days or weeks. As this is a complementary option, it shall not be included as part of the added estimated cost quantification process.

Regarding the above information, contractors have one of two options to finance their construction project: ***construction loans*** and ***commercial loans***. These are used to quantify the increase in contractor's financing costs due to disruptions in interim payments caused by the owner.

Once the contractor has investigated the details of the options, the next decision that has to be contemplated is the ***financing portioning*** (ie. ***full*** or ***partial*** financing). This decision depends on the extent of the contractor's willingness and capacity to invest his or her own funds into the project. In the case of full financing, the contractor should apply for the entire ***maximum cash requirement*** - *the cash availability just prior to receiving the interim payment from the owner (Cooke et al, 1986)* - to finance the project,

whereas in the case of partial financing, only a portion of the maximum cash requirement would be required.

The next step is to decide on the type of the repayment scheme to be adopted. Two existing options exist: the ***defined*** and the ***circumstantial*** repayments. In the case of defined repayment, the loan money is to be drawn completely and repayment is to be made in equal portions (including principal and interest) for a specified period. The repayment figures were established using the following equation (White et al, 1989):

$$A_D = P\ (A/P\ i,n) \qquad (1)$$

Where A_D is the defined periodic repayment figure, P is the loan money drawn and (A/P i,n) is the capital recovery factor.

In the case of circumstantial repayment, the interest would accrue on the used portion of the loan only. However, under normal circumstances, the banks need to secure the granted loan for the borrower, therefore, the contractor will have to pay a fee for the unused portion of the loan known as the ***unused credit commission fee.*** The periodic repayment figures are established using the following equation:

$$A_C = P_{n-1}\ (F - i) - P_n - PF \qquad (2)$$

Where A_C is the circumstantial repayment figure, P_n is the loan money drawn at period n, P_{n-1} is the loan money to be repaid at period n and F is the unused credit commission fee.

It must be noted that both repayment options may be applied to either full or partial financing.

Having decided on the type and repayment of the loan, the next stage is to determine the added financing costs due to disruptions in the contractor's interim payments by the owner which would, in turn, be expressed as an allowance factor. It is recommended that the allowance be added into the bid price. However, contractors may argue that their level of competitiveness may be reduced. Therefore, upon evaluation of the owner, the contractor has the option of including the allowance factor or not. If the owner proves to be *reliable*, the contractor may exclude the addition. On the other hand, had the owner been classified as *non-reliable*, the contractor should include the factor to safeguard him/herself. Under an owner classification of *semi-reliable*, the allowance factor may be included as part of the claims resolution plan which would supplement the contractor's bid. This acts as a mean of minimising the problems associated with claims in the future. Another alternative that a contractor may adopt is to implement the developed model once a payment disruption occurs during the construction stage.

4.3.2. QUANTITATIVE METHODOLOGY

Four financing schemes are available to contractors:

A) *Defined-Full financing*;

B) *Defined-Partial financing*;

C) *Circumstantial-Full financing*;

D) *Circumstantial-Partial financing*.

The quantification of the added financing costs was performed with respect to the above four schemes because it was assumed that external financing would be utilised, as it is the most common path adopted in the Canadian construction industry today.

A) *DEFINED-FULL FINANCING*

Having decided between a construction and a commercial loan, the maximum cash requirement (MCR) for the entire project was determined in accordance with the existing methods. The scheme indicates full financing (100% portioning), in other words, the loan is equal to the maximum cash requirement determined.

In the case of defined repayment, upon determining the maximum cash requirement for the entire project, the contractor will calculate the overall interest payment incurred as part of the requested loan. This payment was assessed by utilising equation 1. In order for this technique to prove its practicalities, the contractor is expected to deposit the granted loan into an interest earning account. Common practice within the Canadian

Table 4.1 - DEFINED FULL FINANCING (DF)

METHODOLOGY		DEFINED FULL FINANCING (DF)
1.	Maximum cash requirement	
2.	Financing portioning	*100 %*
3.	Overall incurred interest from loan (I_L)	$I_L = (A_D \times N) - P$
4.	Single periodic earned interest from deposit	$I_D = D(F/P\ i,n)$ *When* $n=1$, $I_D = Di$
5.	Single periodic earned interest from self-deposited funds	
6.	Net cash flow balance (NCF)	$NCF_{DF} = (P_I + I_D) - (CR_P + LR_P)$
7.	Net payable interest balance (I_N)	$I_N = I_L - \sum_{c=1}^{d} I_{D_c}$ *OR* $I_N = \sum_{a=1}^{b} I_{Pa} - \sum_{c=1}^{d} I_{Dc}$
8.	Distribution of I_N into original cash requirement	$CR_{P'} = I_N \left[\frac{CR_P}{CR_T}\right]$
9.	Recalculate NCF balance with weight distributions	
10.	Simulate payment disruption for each period	
11.	Determine maximum negative cash flow for entire simulation	
12.	Added Financing Costs (C_F)	$C_F = \frac{MCF}{CR_T} \times 100\%$

banks requires that this deposit be performed at the same bank for security and control purposes. In addition, the interest rate applied will be two or three points below that allocated for the loan. However, the interest earned from this deposit will be calculated on a single periodic basis using the following standard equation:

$$I_D = D(F/P\ i,n)$$
$$When\ n=1 \quad I_D = Di \tag{3}$$

Where I_D is the single periodic interest earned from the deposit account, D is the money deposited to earn interest and (F/P i,n) is the single sum, future worth factor.

Based on these calculations, a net cash flow balance model was established, in terms of the earnings and the expenses. The earnings included the interim payments received from the owner and the interest earned from the deposit, while the expenses included the periodic cash requirement and the periodic loan repayment figure.

$$NCF_{DF} = (P_I + I_D) - (CR_P + LR_P) \tag{4}$$

Where NCF_{DF} is the net cash flow balance under defined full financing, P_I is the interim payments received at the same period, CR_P is the periodic cash requirement and LR_P is the periodic loan repayment amount comprising of the periodic principal and interest.

Following the above calculations, the net payable interest is determined by considering the balance between the interest payments to accommodate the loan and the interest earnings from the deposit, simplified in the following equation:

$$I_N = \sum_{a=1}^{b} I_{Pa} - \sum_{c=1}^{d} I_{Dc} \tag{5}$$

Where I_N is the net interest, I_{P_a} is the interest payment at period a, b is the last period to be considered for interest payment, I_{DC} is the interest earned at period c, and d is the last period to be considered for interest earnings.

The net payable interest will then be distributed throughout the original periodic cash flow for the purpose of the calculations. However, it would be included as a separate item under *Interest*, falling under the Head Office charges in the bid estimate to the owner. Several distribution processes were considered. The most compatible system chosen for this study was a weighting mechanism based on the periodic cash requirements and the total project cash requirement shown in the following equation:

$$CR_{P'} = I_N \left[\frac{CR_P}{CR_T} \right] \qquad (6)$$

Where $CR_{P'}$ is the adjusted (weighted) periodic cash requirement and CR_T is the total project cash requirement.

Another net cash flow balance model, similar to the one discussed above, was performed, except the interim payments were adjusted in accordance with the weighted periodic cash flow causing the overall cash flow balance to equal approximately zero. The quantification process assumed that the worst scenario would occur. In other words, the contractor maintained the work according to the original work schedule and payments to subcontractors, suppliers and labour for completed work was to continue regardless of whether payment disruption by the owner to the contractor occurred at one or two consecutive periods. Referring to the advice and experiences of the professionals in the

industry today, the worst scenario was identified as a payment disruption for two consecutive periods, as contractors would be unable to sustain the work and become vulnerable to bankruptcy. The loan repayments were then disrupted for the same period as the payment disruption. This shift would take into account the interest increase of the payment relocation.

The net cash flow balance for each disruption occurrence was performed and the lowest value obtained, ie. the maximum negative cash flow balance, was identified and defined as a percentage of the total cash requirement for the entire project. That percentage would then be treated as the ***added financing costs*** incurred due to the disruption in the contractor's interim payments for the entire project, which the following equation indicates:

$$C_F = \frac{MCF}{CR_T} \times 100\% \qquad (7)$$

Where C_F is the added financing costs and MCF is the maximum negative cash flow balance.

A summary of the methodology is illustrated in Table 4.1.

B) ***DEFINED-PARTIAL FINANCING***

This scheme is similar to the above except that the financing portionings are variable and are dependant on the contractor's willingness to invest his/her own funds into the project. The portion of funds adopted as self-financing would be deposited into another separate

Table 4.2 - DEFINED PARTIAL FINANCING (DP)

METHODOLOGY		DEFINED PARTIAL FINANCING (DP)
1.	Maximum cash requirement	
2.	Financing portioning	$X\ \%$
3.	Overall incurred interest from loan (I_L)	$I_L = (A_D \times N) - P$
4.	Single periodic earned interest from deposit	$I_D = D(F/P\ i,n)$ $When\ n=1,\ I_D = Di$
5.	Single periodic earned interest from self-deposited funds	$I_{SD} = D(F/P\ i,n)$ $When\ n=1,\ I_{SD} = Di$
6.	Net cash flow balance (NCF)	$NCF_{DP} = (P_I + I_D + I_{SD}) - (CR_P + LR_P)$
7.	Net payable interest balance (I_N)	$I_N = I_L - \sum_{c=1}^{d} I_{D_c}$ *OR* $I_N = \sum_{a=1}^{b} I_{Pa} - \sum_{c=1}^{d} I_{Dc}$
8.	Distribution of I_N into original cash requirement	$CR_{P'} = I_N \left[\frac{CR_P}{CR_T}\right]$
9.	Recalculate NCF balance with weight distributions	
10.	Simulate payment disruption for each period	
11.	Determine maximum negative cash flow for entire simulation	
12.	Added Financing Costs (C_F)	$C_F = \frac{MCF}{CR_T} \times 100\%$

interest earning account, probably with a higher interest rate. The interest earned is included in the quantification process. Therefore, Equations 4 and 5 shall differ as follows :

$$NCF_{DP} = (P_I + I_D + I_{SD}) - (CR_P + LR_P) \quad (8)$$

$$I_N = \sum_{a=1}^{b} I_{Pa} - [\sum_{c=1}^{d} (I_{Dc} + I_{SDc})] \quad (9)$$

Where NCF_{DP} is the net cash flow balance under defined partial financing and I_{SD} is the interest earned from self deposited funds. The procedural steps used in the previous scheme was used to quantify the added financing costs to the contractor. A summary of the methodology is illustrated in Table 4.2.

C) *CIRCUMSTANTIAL-FULL FINANCING*

Similar to Scheme A, full financing defines a financing portioning of 100%. However, in the case of circumstantial repayment, the loan was utilised with respect to the periodic cash requirements. Based on the withdrawals performed, three items were included in the succeeding month's repayment figures: the actual funds withdrawn; the interest accrued from the withdrawn funds; and the unused credit commission fee. Based on these calculations, the procedure adopted for the defined repayment was used again to determine the added financing costs incurred due to the disruption. However, the only difference that needs to be identified is that the interest earning deposit account does not exist, thus causing Equations 4 and 5 to change as follows:

$$NCF_{CF} = P_I - (CR_P + LR_P + F) \quad (10)$$

Where NCF_{CF} is the net cash flow balance under circumstantial full financing.

$$I_N = \sum_{a=1}^{b} I_{Pa} \quad (11)$$

A summary of the methodology is illustrated in Table 4.3.

D) *CIRCUMSTANTIAL-PARTIAL FINANCING*

Similar to Scheme B, partial financing defines a variable financing portioning, therefore, the interest earned from the self deposited funds was included in the calculation of the added financing costs. Once again, Equations 4 and 5 differ as follows:

$$NCF_{CP} = (P_I + I_{SD}) - (CR_P + LR_P + F) \quad (12)$$

$$I_N = \sum_{a=1}^{b} I_{Pa} - \sum_{c=1}^{d} I_{SDc} \quad (13)$$

Where NCF_{CP} is the net cash flow balance under circumstantial partial financing.

A summary of the methodology is illustrated in Table 4.4.

4.3.3. SUMMARY

This section gave a complete explanation and interpretation of the determination of the added financing costs incurred from disruptions in the contractor's interim payments from the owner with respect to the four financing schemes that are currently available to the Canadian construction industry.

Table 4.3 - CIRCUMSTANTIAL FULL FINANCING (CF)

METHODOLOGY		CIRCUMSTANTIAL FULL FINANCING (CF)
1.	Maximum cash requirement	
2.	Financing portioning	*100 %*
3.	Overall incurred interest from loan (I_L)	$I_L = \sum_{c=1}^{f} A_c$
4.	Single periodic earned interest from deposit	
5.	Single periodic earned interest from self-deposited funds	
6.	Net cash flow balance (NCF)	$NCF_{CF} = P_I - (CR_P + LR_P + F)$
7.	Net payable interest balance (I_N)	$I_N = I_L - CCR$ *OR* $I_N = \sum_{a=1}^{b} I_{Pa} - CCR$
8.	Distribution of I_N into original cash requirement	$CR_{P'} = I_N \left[\frac{CR_P}{CR_T}\right]$
9.	Recalculate NCF balance with weight distributions	
10.	Simulate payment disruption for each period	
11.	Determine maximum negative cash flow for entire simulation	
12.	Added Financing Costs (C_F)	$C_F = \frac{MCF}{CR_T} \times 100\%$

Table 4.4 - CIRCUMSTANTIAL PARTIAL FINANCING (CP)

METHODOLOGY	CIRCUMSTANTIAL PARTIAL FINANCING (CP)
1. Maximum cash requirement	
2. Financing portioning	$X\ \%$
3. Overall incurred interest from loan (I_L)	$I_L = \sum_{c=1}^{f} A_c$
4. Single periodic earned interest from deposit	
5. Single periodic earned interest from self-deposited funds	$I_D = D(F/P\ i,n)$ *When* $n=1$, $I_D = Di$
6. Net cash flow balance (NCF)	$NCF_{CP} = (P_I + I_{SD}) - (CR_P + LR_P + F)$
7. Net payable interest balance (I_N)	$I_N = I_L - \sum_{c=1}^{d} I_{SD_c}$ *OR*
8. Distribution of I_N into original cash requirement	$CR_{P'} = I_N \left[\frac{CR_P}{CR_T}\right]$
9. Recalculate NCF balance with weight distributions	
10. Simulate payment disruption for each period	
11. Determine maximum negative cash flow for entire simulation	
12. Added Financing Costs (C_F)	$C_F = \frac{MCF}{CR_T} \times 100\%$

4.4. IMPACT COSTS : REDUCTION IN PROGRESS RATE

From the literature review performed earlier, there is no indication that a study which directly relates disrupted payments with reductions in progress rates has been carried out. The disruption causes a reduction in progress which results in impact costs being incurred. Therefore, the concept of impact costs was used to quantify the consequence of the disruptions. Impact costs tend to be difficult to define because they originate from one or more isolated problems, which then spread with increased effect through a project like ripples in a pond (Revay, 1987; 1990; Brunies, 1988). The concept of impact costs arises from the quantification of claims.

Impact costs are sometimes referred to in different manners, such as consequential delay cost; acceleration cost; disruption cost; loss of labour output; loss of productivity and ripple effects (Brunies, 1988).

Several factors cause impact costs such as, frequent change orders, delays, disruptions, acceleration, changes in site conditions, labour disruption and inclement weather (Baldwin et al, 1971; Brunies, 1988; Leonard et al, 1988; Moselhi et al, 1990; 1990).

Through various administrative and authoritative organisations, guidelines to the way impact costs can be quantified using *differential cost method, estimating method and total cost method* were produced (Revay, 1985; 1990; Brunies, 1988; Heather, 1989; Moselhi, 1990).

DIFFERENTIAL COST METHOD :

This is a classical approach which compares the actual cost of the impacted operation with the actual cost incurred while performing the same work, but in an unimpacted mode. Therefore, it compares the actual productivity with the expected or anticipated productivity. The difference identifies the loss of productivity.

ESTIMATING METHOD :

Statistical information gathered from the work of various administrative and authoritative organisations is used for estimating either the most likely losses under definable circumstances, or quantifying loss of productivity. This method is used when the differential method is not practical.

The three most important statistical charts used for estimating purposes are :

Overtime : Several statistical studies to assist in the quantification of the effect of overtime with regard to productivity losses have been conducted by the US Department of Labour (1948), the Mechanical Contractors' Association (MCA, 1969), the National Electrical Contractors' Association (NECA, 1969), the US Corps of Engineers (1979) and the US Business Roundtable (1980).

Overmanning : This chart was produced by the US Corps of Engineers (1979) and indicates the drop in productivity resulting from the increase in the crew size or number of crews.

Stop-and-Go : This chart was produced by Foster Wheeler Organisation (O'Connor) and indicates the time required to remobilise and reorient a crew after variable lengths of absence from the activity in question. It shows loss in time and productivity.

TOTAL COST METHOD :

This method is used when neither of the above can be used. This approach is based on the difference between the contractors actual cost and their contractual revenues. This value does not indicate or make reference to the actual effect of the delay caused solely by the impact activities.

It should be noted that the order of the three methods explained above is the order by which owners prefer to quantify claims if necessary. However, the contractor's preference is vice versa.

As interim payment disruptions give rise to impact costs, it was found that differential cost and estimating methods, explained above, require data that only exists once a delay has occurred or a project been completed. Therefore, the total cost method was chosen for the quantification of the reduction in progress rates (impact costs). However, slight modifications were made for application purposes. The actual cost of the project was changed to become the anticipated costs incurred due to the occurrence of a payment disruption.

4.4.1. QUALITATIVE THEORY

Various factors contribute to delays in the work progress, such as poor organisation, variation orders, strikes, material shortages, etc. (Leary et al, 1988; Reams, 1990; Alkass et al, 1991; Kraiem et al, 1991). Another very important contributing factor to the discrepancy has been identified as a result of the contractor's actions arising from disruptions in interim payments by the owner. As mentioned earlier, the contractor has three options in order to remedy the effect of the disruptions: allocation of extra funds (as quantified in Section 4.3); reduction of the progress rate either in order to encourage the owner to release payment sooner or for reasons beyond the contractor's control, due to the lack of funds which would ultimately lead to the limited availability of resources to perform the work; and finally, to stop the work completely for the duration of the disruption. The latter scenario is the most pessimistic and non favourable because it may affect the contractor's credibility for future prospects as well as his/her reputation within the industry. With regard to this study, it can be determined that the second remedial option would also be taken by the contractor in the case of payment disruptions to the owner.

However, as the extent of a reduction in progress has not yet been clearly defined, the quantification process considers the most pessimistic approach, the third option. As this is an extreme situation (ie. worst scenario), the contractor will automatically be safeguarded when any disruptions occur during the construction stages of the project.

4.4.2. QUANTITATIVE METHODOLOGY

Having considered various theories to be implemented for the purpose of this study, it was found that the most suitable concept revolved around the fundamental principles of the Indices methodology (Ferry et al,1988).

$$I = \frac{(X_n - X_B) \times 100}{X_B} + 100 \qquad (14)$$

where I is the Index value, X_n is the current cost and X_B is the base cost.

Ferry et al (1988) defined the purpose of a cost index as "to measure changes in the cost of an item or group of the items from one point in time to another. A base date is chosen and is usually given the value of 100, all future increases or decreases being related to this figure." It must be noted that the index principles are not fixed in terms of cost, but may be applied for any variable. These principles have been modified to fall within the context of this study, to form a relation between the durations of all activities and the overall project at specific times of the schedule, while also quantifying the reduction in progress rate in monetary terms at the bidding stage. These results shall be implemented into the original work schedule (by a weighting process) to produce a *safeguarded* work schedule.

Three assumptions were considered in the derivation of this model:

1. The base periodic project durations were in accordance with the original work schedule;
2. The base index was identified as the original durations of the critical activities;

3. For whatever period the owner disrupts the payment, the contractor shall put a complete stop to all the works and shall recommence only when payment is released. This assumption was made in order to signify the worst scenario or most pessimistic approach.

By performing the above modifications, the basic principles of indices (Ferry et al, 1988) were adopted and modifies to determine the increase in remaining project duration index with respect to the overall project duration at the time of payment disruption as shown below (Awad et al, 1992; 1993):

$$IR = \frac{(P_D - P_O)\ X\ 100}{P_O} + 100 \qquad (15)$$

Where IR is the increase in remaining project duration index, P_O is the original remaining project duration prior to the disruption and P_D is the delayed project duration.

This increase was compared to the original work schedule and defined in percentage terms using:

$$P_R = \frac{(IR - 100) \times 100}{100} \qquad (16)$$

Where P_R is the percentage increase in remaining project duration.

Determining the percentage increase in remaining project duration allows the effect to highlight the critical activities that fall within the disruption period. The purpose was to

quantify the effective activity duration at that period (ie. period of disruption) using the following equation:

$$A_E = A_O (1 - P_R) \quad (17)$$

Where A_E is the effective activity duration and A_O is the original activity duration.

The effective activity duration can then be compared to the original activity duration for the same period allowing for the quantification of the overall reduction in the critical activity's progress rate due to the disruption. This may also be interpreted as the overall increase in the critical activity's duration. As shown by:

$$A_{RED} = A_O - A_E \quad (18)$$

Where A_{RED} is the overall reduction in the critical activity's progress rate.

Quantification of the reduction in the critical activities progress rates allows the contractor to predict the extent by which the schedule would be affected if the owner disrupted any one or two consecutive interim payments at any time throughout the project. Based on the previous results, the maximum reduction in critical activities progress rates (MA_{RED}) and its period of coincidence (PMA_{RED}) were identified. The maximum reduction value took into account the reduction rates that occurred prior to the period of maximum reduction. However, if the maximum determined value was exhausted prior to the expected period of occurrence, then the activities falling after the maximum period were to be deprived from any expected allowances in time. Therefore, the maximum reduction rate needed to be distributed to the activities which occur at and after that maximum

period would use a weighting process of the corresponding activities. This is shown in the following equations:

$$A_{O'} = W_O \times MA_{RED} \tag{19}$$

$$W_O = \frac{A_O}{\sum_{i=m}^{n} A_{Oi}} \; ; \quad m \leq i \leq n \tag{20}$$

Where $A_{O'}$ is the activity adjustment duration and W_O is the activity weight at period i.

The maximum reduction value was identified and distributed to the affected activities in order to establish an adjusted original activity duration for the period of disruption using:

$$A^*_O = A_{O'} + A_O \tag{21}$$

Where A_o^* is the adjusted original activity duration.

As a result, the adjusted durations were to be inputed into the project management software for re-scheduling.

However, the main criteria in determining the effect of the disruption in interim payments in terms of the impacted costs associated with the reduction in the progress rate, is to quantify the expected reduction in monetary terms.

The calculation of the maximum activity reduction rate as a percentage of the remaining project duration from the period when the disruption occurred indicates the effective progress reduction on the remaining project duration, shown as follows:

$$E_{PR} = \frac{MA_{RED}}{D_{RP}} \times 100\% \qquad (22)$$

Where E_{PR} is the effective progress reduction on the remaining project duration and D_{RP} is the remaining project duration.

Applying this value to the original remaining project cost will give the effective remaining project cost. This cost can be interpreted as the impacted cost.

$$C_{RE} = (1 + E_{PR}) \times C_{RO}$$
$$\therefore \quad C_{RE} = IC \qquad (23)$$

Where C_{RE} is the effective remaining cost, C_{RO} is the original remaining cost and IC is the impact cost on the remaining project cost due to the disruption.

In turn, adding this value to the accumulated incurred costs defined the effective total project cost, as shown below:

$$C_{ET} = C_{RE} + C_{<MA_{RED}} \qquad (24)$$

Where C_{ET} is the total effective project cost and $C_{<MARED}$ is the accumulated incurred costs until the period of maximum reduction.

The overall impact cost would then be expressed as a percentage of the difference between the effective total and original total project costs. By implementing the typical concepts used in distributing markup values equally against the overall project duration, the overall impacted cost percentage is equally distributed throughout the project duration.

Results from this research work, with regard to this aspect, indicates that the highest impact would occur towards the end of the project. Consequently, applying the impact costs in an undistributed mode would highly inflate the allowance factor with regard to reductions in progress rates. In the event that a disruption occurs prior to the predicted period, the main problem that the contractor will face is receiving the safeguarded monies at a later date than expected. The allowance factor is calculated as shown below:

$$C_P = \frac{C_{ET} - C_{OT}}{N.C_{OT}} \times 100\% \qquad (25)$$

Where C_P is the overall impacted costs in terms of reduction in progress rate, C_{OT} is the original total cost of the project and N is the number of project periods.

4.4.3. SUMMARY

This section gave a complete explanation and interpretaion of the determination of impact costs incurred from disruptions in the contractor's interim payments from the owner with respect to the reduction in progress rate of the contractor's scheduled work.

4.5. OVERALL CONSEQUENCES OF THE DISRUPTIONS

As a result of quantifying the added financing costs and the impact costs in terms of a reduction in progress rates, the overall consequences to the contractor can now be considered as an allowance factor determined using the following equations:

$$A_L = (C_{OT} \times C_F) + (C_{OT} \times C_P) \qquad (26)$$

$$\therefore \; A_L = C_{OT}\,(C_F + C_P) \qquad (27)$$

Where A_L is the allowance needed to offset the consequences of the payment disruptions.

Taking into consideration the determination of several items throughout this work, a summary of the bid price calculation is shown in Table 4.5.

4.6. CONCLUSION

A quantification model to determine the consequences of the disruptions in interim payments enables the contractor to implement it at the bidding stage, making him/her aware of the unexpected costs that may arise during the construction phase and can be accounted for as an allowance factor to prevent future problems which may lead to bankruptcy.

Table 4.5 - SUMMARY OF BID PRICE CALCULATIONS

Direct Labour		
Direct Material		
Equipment		
Engineering		
		DIRECT COSTS
Field		
Specials		
	VARIABLE O/H's	
Head Office		
	FIXED O/H's	
		INDIRECT COSTS
		PROJECT COST ESTIMATE
		PROFIT (MARKUP)
		BID PRICE

CHAPTER 5

CASE STUDIES

Having established a model, it became necessary to validate its applicability in terms of the qualitative theories and quantitative methodologies. The validation process was performed by applying the model to different cases. Four actual case studies were obtained from construction management consultants and independent contractors. These four cases were modified for implementation purposes as it was difficult to extract the necessary information needed to perform the quantification process. Fifteen other cases were derived by altering the total costs of the project and the financing portioning variables for each of the four cases as shown in Table 5.1. The total costs of the projects ranged between approximately $100,000 and $6.5 million, projecting required allowances between approximately 0.3% and 0.7% of the total project cost. The financing portioning for each case was varied by ±20% (in 10% increments) to establish sixty cases used for the validation process.

5.1. CASE STUDY

A documented case (Cooke et al, 1986) was chosen and modified according to the sixty cases demonstrate the quantification process of the developed model. The project is medium sized, estimated by the contractor at approximately $2.1 million with a duration of one year (12 months). Table 5.2 identifies the activities,

durations and costs, while Table 5.3 identifies the estimated periodic cash requirements needed by the contractor to perform the specified work. This is based on the monetary and duration bar chart in Figure 5.1. The main objective is for the contractor to quantify the consequences of disruptions in their interim payments caused by the owner. Therefore, the contractor shall perform simulations consisting of one individual and two consecutive interim payments disruptions. The overall effect on both the financing costs and the progress rate (impact costs) shall be determined for each period separately. This would, in turn, be quantified as a percentage allowance factor to be included in the bid price submitted for the owner's consideration. A complete run of these simulations are presented in Appendix A.

Table 5.1 - RESULTS OF MODEL APPLICATION FOR DIFFERENT CASES

CASE NO.	C_{OT}	X	C_F (%)				C_P	ALLOWANCE (%)			
			DF	DP	CF	CP	(%)	DF	DP	CF	CP
1	$116 610	50%	0.082	0.051	0.119	0.118	0.139				
			0.237	0.132	0.356	0.355	0.198	0.435	0.330	0.554	0.553
2	$229 979	50%	0.044	0.013	0.113	0.113	0.317				
			0.041	0.026	0.319	0.319	0.317	0.358	0.343	0.636	0.636
3	$320 760	40%	0.068	0.083	0.095	0.116	0.312				
			0.197	0.154	0.264	0.284	0.317	0.514	0.471	0.581	0.601
4	$320 760	50%	0.068	0.075	0.095	0.094	0.312				
			0.197	0.147	0.264	0.263	0.317	0.514	0.464	0.581	0.580
5	$328 400	50%	0.082	0.059	0.121	0.120	0.167				
			0.237	0.140	0.339	0.338	0.286	0.523	0.426	0.625	0.624
6	$882 095	50%	0.068	0.075	0.095	0.094	0.312				
			0.197	0.147	0.264	0.263	0.317	0.514	0.464	0.581	0.580
7	$882 095	60%	0.068	0.066	0.095	0.133	0.312				
			0.197	0.139	0.264	0.302	0.317	0.514	0.456	0.581	0.619

8	$2 299 790	50%	0.044	0.013	0.113	0.113	0.317				
			0.041	0.026	0.319	0.319	0.317	0.358	0.343	0.636	0.636
9	$2 299 790	90%	0.044	0.009	0.113	0.118	0.317				
			0.041	0.027	0.319	0.324	0.317	0.358	0.344	0.636	0.641
10	$4 372 875	30%	0.082	0.073	0.119	0.147	0.139				
			0.237	0.151	0.356	0.384	0.198	0.435	0.349	0.554	0.582
11	$4 372 875	50%	0.082	0.051	0.119	0.118	0.139				
			0.237	0.132	0.356	0.355	0.198	0.435	0.330	0.554	0.553
12	$4 599 700	50%	0.044	0.013	0.113	0.113	0.317				
			0.041	0.026	0.319	0.319	0.317	0.358	0.343	0.636	0.636
13	$4 599 700	80%	0.044	0.008	0.113	0.113	0.317				
			0.041	0.024	0.319	0.319	0.317	0.358	0.341	0.636	0.636
14	$6 568 000	50%	0.082	0.059	0.121	0.120	0.167				
			0.237	0.140	0.339	0.338	0.286	0.523	0.426	0.625	0.624
15	$6 568 000	70%	0.082	0.038	0.121	0.194	0.167				
			0.237	0.121	0.339	0.412	0.286	0.523	0.407	0.625	0.698

C_{OT} = Original Total Cost (%) **C_F = Added Financing Cost (%)**
X = Financing Portioning Variable (%) **C_P = Reduction in Progress Rate (%)**

Figure 5.1 - MONETARY AND DURATION BAR CHART FOR THE SAMPLE CASE STUDY

Activity	Budget ($)	January	February	March	April	May	June	July	August	September	October	November	December
30 B100	180,000	26 4 156,000	4 0 6,000										
c 60 B200	*292,000*	*26 34 126,520*	*29 5 141,230*	*5 0 24,350*									
90 B300	330,000		25 65 91,750	31 34 113,770	30 4 110,100	4 0 14,680							
c 90 B400	*420,000*				*26 64 121,420*	*31 33 144,770*	*30 3 140,100*	*3 0 14,010*					
c 60 B500	*194,000*							*28 32 90,440*	*31 1 100,130*	*1 0 3,230*			
60 B600	56,000						27 33 25,110	31 2 28,830	2 0 1,860				
120 B700	244,000							28 92 56,840	31 61 62,930	30 31 60,900	31 0 62,930		
60 B800	120,000									29 31 58,000	31 0 62,000		
c 120 B900	*320,000*									*29 91 77,430*	*31 60 82,770*	*30 30 80,100*	*30 0 80,100*
	2,138,400	282,620	238,980	138,120	231,520	159,450	165,210	190,120	164,920	199,560	207,700	80,100	80,100

AA	BB
CC	

AA : Number of days of work completed for a specific activity in a particular month.

BB : Number of days of work remaining to complete the specific activity.

CC : Cost of performing the work in a particular month.

[ ] : Critical Activity

Table 5.2 - SUMMARY OF PROJECT ACTIVITIES

Activity	Description	Duration	Cost ($)
B100	Set-up site	30	180,000
B200	Reduce level excavation	60	292,000
B300	Drainage and manholes	90	330,000
B400	Road base and sub-base	90	420,000
B500	Road surfacing	60	194,000
B600	Pumphouse excavation	60	56,000
B700	Pumphouse base and walls	120	244,000
B800	Intake connections	60	120,000
B900	Plant and equipment	120	320,000

Table 5.3 -
ESTIMATED PERIODIC CASH REQUIREMENTS

Period	Periodic Cash Requirement ($)
1	282,620
2	238,980
3	138,120
4	231,520
5	159,450
6	165,210
7	190,120
8	164,920
9	199,560
10	207,700
11	80,100
12	80,100
CR_T	2,138,400
MCR	282,620

The variables used for the case study are as follows :

Loan Interest = *9% per annum* = *0.75% per month*

Deposit Interest = *6% per annum* = *0.50% per month*

Financing Portioning = *50%*

Unused Credit Commission Fee factor = *0.0025.*

5.2. DISCUSSION OF RESULTS

The results of implementing the above mentioned theories are shown in Table 5.4 and 5.5. Therefore, referring to Equation 27, Table 5.6 identifies the allowance factors for each financing scheme tested. The lowest factor will then be chosen to be included in the bid price estimate (see Table 4.5) as this would be the scheme exposing the least problems should the contractor face interim payment disruptions. In this particular case, the contractor might include an allowance of 0.465% of the total project cost by adopting the defined partial financing scheme, investing 50% of the required funds from his/her own sources. In addition, the owner would be charged a net payable interest sum of $4,997.

At this stage, the contractor can determine a markup value to be included in the bid price ready for submission to the owner.

Table 5.4 - ADDED FINANCING COSTS (C_F)

Financing Scheme	1-Disruption	2-Disruption
Defined - Full	0.068 %	0.197 %
Defined - Partial	0.075 %	0.147 %
Circumstantial - Full	0.095 %	0.264 %
Circumstantial - Partial	0.094 %	0.263 %

Table 5.5 - IMPACT COSTS (C_P)

Number of Disruptions	C_P
1	0.313 %
2	0.318 %

Table 5.6 - ALLOWANCE FACTOR (A_L)

Financing Scheme	C_F 2-Period	C_P 2-Period	A_L
DF	0.197 %	0.318 %	0.515 %
DP	*0.147 %*	*0.318 %*	*0.465 %*
CF	0.264 %	0.318 %	0.582 %
CP	0.263 %	0.318 %	0.581 %

CHAPTER 6

CONCLUSION

The bidding stage of a construction project tends to be a critical stage for the contractor especially in a highly competitive market. Bidding is performed at the pre-construction stage of a project and deals at large with forecasting, speculation and personal experience. This means that a variety of judgemental decisions must be taken. Thus, bids tend to exhibit some degree of discrepancy under actual circumstances due to the inaccuracies of the decisions taken earlier.

Construction delays tend to be unavoidable during the construction life of projects. These delays eventually affect the contractor in one of several ways, such as monetary or time wise. However, the techniques regarding delay analysis available to contractors can only be used once the actual delays have occurred.

Due to difficult economic circumstances, owners would normally face a shortfall in the cash availability. Thus, interim payments to their contractors would be disrupted.

Based on the literature review performed at the beginning of this research, it became obvious that dealing with uncertainties at the forecasting stages of the

project was of major concern to many. However, most of the research work involved with uncertainties adopted the use of random number generations (PERT system) as well as probabilistic and statistical theories, which are complicated for contractors to use.

During this research work, it was determined that due to the disruptions in contractor's interim payments by the owner, the contractor faces two problems: ***added financing costs*** and a ***reduction in progress rates (impact costs).***

A mathematical model was developed to assist contractors in quantifying these consequences, expressed as an allowance percentage. Depending on the contractor's evaluation of the owner, the allowance factor may be added directly into the bid estimate or eliminated completely. However, for the purpose of maintaining a high competitive level, the contractor could include the allowance as part of a claim resolution plan, or to be included once the delay occurs.

The proposed model was validated using sixty cases which originate from four actual cases obtained from construction managers and independent contractors. The results seemed to be acceptable to the practitioners interviewed during the development process.

The main advantage of this development is that contractors may implement the system during the bidding stage to assist them in reducing the effect of possible problems that might occur in the future, perhaps bankruptcy. This may prove to be beneficial to the industry, as it allows contractors to adopt the model to satisfy their own project's needs avoiding complex and sophisticated mathematical solutions. In addition, the model is unique because it utilises a systematic/non-probabilistic approach to target the identification and quantification of the uncertainties.

Another major development within the proposed model was the identification of a relationship between disruptions in the contractor's interim payments and the work schedule, which is expressed in monetary terms.

6.1. FUTURE RESEARCH

Several possibilities for future research work involve expansion and further development of the proposed existing model. These include:

- The model can be implemented into a complete field trial in order to identify possible areas of modification.
- The model may be modified to suite large scale projects.

- The possibility of identifying and quantifying other uncertainties, such as cost overruns, change orders and inflation, can be performed which may be integrated with this work to serve as a more realistic approach.
- The development of a knowledge based expert system to take this work into account may prove to have promising prospects, especially in the field of risk management, bidding and scheduling.
- Implementing the results of this study along with other existing or current studies into systems designed to perform delay analysis. This may eventually grow into a full size system allowing contractors who are preparing bid estimates to account for various unexpected mishaps, including those related to payment disruptions by the owner, at a more confident and competitive level.

REFERENCES

AHMAD, I. and MINKARAH, I. (1987). "*An expert system for selecting bid markups*", Journal of Computing in Civil Engineering, 229-238.

AHMAD, I. and MINKARAH, I. (1988). "*Questionnaire Survey on Bidding in Construction*", Journal of Management in Engineering, ASCE, July, 4(3), 229-243.

AL-BAHAR, J.F. and CRANDALL, K.C. (1990). "*Risk Management in Construction Projects : A Systematic Approach for Contractors*", Proceedings of International Symposium in Building Economics and Construction Management, CIB, Sydney, Australia, March, 6, 43-55.

ALKASS S., MAZEROLLE M. and HARRIS F. (1991). "*An Integrated System for the Assessment of Construction Claims with Minimum Analysis Cost*", Journal of Building Research and Information, 19(1), 15-22.

AWAD, H. and ALKASS, S. (1992). "*Construction Delays: An Overview of Disrupted Interim Payments by the Client*", Proceeding of the 8th annual Association of Researchers in Construction Management Conference, Douglas, Isle of Man, U.K., 49-60.

AWAD, H. and ALKASS, S. (1993). "*Quantifying Contractor's Risk due to the Interim Payments Disruptions*", Proceedings of the Canadian Society for Civil Engineers Annual Conference, Fredericton, New Brunswick, Canada, June, 213-222.

BALDWIN, J.R., MANTHEI, K.M., ROTHBART, H. and HARRIS, R.B. (1971). "*Cases of Delay in the Construction Industry*", Journal of the Cost Division, ASCE, 97(CO2), 177-187.

BINHAMMER, H. (1988). Money, Banking and the Canadian Financial System, 5th Ed., Nelson Canada, Ontario, Canada.

BOWERS, J. (1988). "*Project Risk Analysis*", Paper to Institute of Mathematics and its Applications, Glasgow College, UK.

BRUNIES, R.A. (1988). "*Impact Costs - What are they? And how to quantify them*", Proceedings of the Project Management Institute Seminar/Symposium, San Francisco, California, USA, September, 386-393.

The Business Roundtable, (1990). "*Scheduled Overtime Effect on Construction Projects*", Construction Industry Cost Effectiveness Task Force Report, November.

CARR, R.I. (1982). *"General Bidding Model"*, Journal of the Construction Division, ASCE, December, 108(CO4), 639-650.

CARR, R.I. (1987). *"Optimum Markup by Direct Solution"*, Journal of Construction Engineering and Management, ASCE, March, 113(1), 138-150.

COOKE, B. and JEPSON, W. (1986). Cost and Financial Control for Construction Firms, Macmillan Education Ltd., London, U.K.

CUSACK, M.M. (1985). *"A Simplified Approach to the Planning and Control of Cost and Project Duration"*, Journal of Construction Management and Economics, 3, 183-198.

FERRY and BRANDON, (1988). Cost Planning of Buildings, 5th Ed., BSP Professional Books, U.K.

FRIEDMAN, L.A. (1956). *"A Competitive Bidding Strategy"*, Operations Research, February, 4(1), 104-112.

FUNDUK, M. (1991). *"Subcontractors not paid when owner refuses to pay general for sub's work"*, Construction Law Letter, 7(3), Canada.

GATES, M. (1967). *"Bidding Strategies and Probabilities"*, Journal of the Construction Division, ASCE, March, 93(CO1), 75-107.

GATES, M. (1971). *"Bidding Contingencies and Probabilities"*, Journal of Construction Division, ASCE, November, 97(CO2), 277-303.

GIBSON, R.F. (1992). *"Construction Contracts and Risk"*, Proceedings of the Architecture Management Conference, CIB, Nottingham, U.K., 134-143.

HALPIN, D. (1985). Financial and Cost Concepts for Construction Management, John Wiley and Sons, Toronto, Canada.

HALPERIN, D. and COLLIER, C. (1984). Construction Funding, Where the Money Comes From, 2nd Ed., John Wiley and Sons, Toronto, Canada.

HAMBURGER, D. (1987). *""On Time" Project Completion - Managing the Critical Path"*, Proceedings of the Project Management Institute Seminar/Symposium, Milwaukee, Wisconsin, USA, October, 69-76.

HAMBURGER, D. (1989). "*Contingencies - Planning for Project Uncertainty*", Proceedings of the Project Management Institute Seminar/Symposium, Atlanta, Georgia, USA, October, 204-210.

HEATHER, P.R. (1989). "*Mathews Curve - A Model for Evaluating Impact*", AACE Transactions, I.4.1-I.4.6.

KAKA, A. and PRICE, A.D.F. (1991a). "*Net Cash Flow Models: Are they reliable?*", Journal of Construction Management and Economics, 9, 291-308.

KAKA, A. and PRICE, A.D.F. (1991b). "*Relationship Between Value and Duration of Construction Projects*", Journal of Construction Management and Economics, 9, 383-400.

KENLEY, R. and WILSON O.D. (1989). "*A Construction Project Net Cash Flow Model*", Journal of Construction Management and Economics, 7, 3-18.

KERRIDGE, A.E. (1986). "*Contingency, Risk and Sensitivity Analysis*", Engineering and Construction Project Management, 239-252.

KRAIEM, Z.M. and DIEKMANN, J. (1987). "*Concurrent Delays in Construction Projects*", Journal of Construction Engineering and Management, ASCE, 113(4), 591-602.

LEARY, C.P. and BRAMBLE B.B. (1988). "*Project Delays: Schedule Analysis Models and Techniques*", Proceedings of the Project Management Institute Seminar/Symposium, San Francisco, California, USA, September, 63-69.

LEONARD, C.A., FAZIO, P. and MOSELHI, O. (1988). "*Construction Productivity: Major Causes of Impact*", AACE Transactions, D.10.1-D.10.7.

LOTUS, Lotus 1-2-3 and Reference Manual, Lotus Development Corporation.

MAZEROLLE, M. (1992). "*Cost effective Approach for Delay Analysis and Claims Preparation*", Major Technical Report, CBS, Concordia University, Montreal, Quebec, Canada, November.

McKIM, R.A. (1992). "*Risk Management - Back to Basics*", Cost Engineering, December, AACE, 34(12), 7-12.

MCA, (1969). *"How Much Does Overtime Really Cost?"*, Mechanical Contractor's Association of America, Bulletin 18A.

MOSELHI, O., LEONARD, C. and FAZIO, P. (1990). *"Change Orders: Source and Impact"*, Proceedings of International Symposium in Building Economics and Construction Management, CIB, Sydney, Australia, 6, 323-334.

MOSELHI, O. and NICHOLAS, M.J. (1990). *"Quantification of Impact Costs: A Knowledge Based Approach"*, Proceedings of the Project Management Institute Seminar/Symposium, Calgary, Alberta, Canada, October, 717-725.

MOSELHI, O. and DEB, B. (1993). *"Project Selection Considering Risk"*, Journal of Construction Management and Economics, 11, 45-52.

NECA (1969). Overtime and Productivity in Electrical Construction, National Electrical Contractor's Association, Washington, USA.

NEUFVILLE, R.de. and KING, D. (1991). *"Risk and Need-For-Work Premiums in Construction Bidding"*, Journal of Construction Engineering and Management, ASCE, 117(4), 659-673.

O'CONNOR, L.V., Overcoming the Problems of Construction Scheduling in Large Central Boilers, Foster Wheeler Corporation, Livingston, New York, USA.

PARKINSON, C.N. (1980) " Parkinson: The Law", Houghton Mifflin.

PRIMAVERA, (1991). Primavera Project Planner and Reference Manual, Primavera Systems Inc.

RANKIN, J.H., CHAMPION, S.L., and LLOYD, W.M. (1993). "*Contractor Selection: Qualification and Bid Evaluation*", Proceedings of the Canadian Society for Civil Engineers annual conference, Fredericton, New Brunswick, Canada, June, 203-212.

REAMS, J. (1989). "*Delay Analysis: A Systematic Approach*", Cost Engineering, AACE, February, 31(2).

REAMS, J. (1990). "*Substantiation and Use of Planned Schedule in a Delay Analysis*", Cost Engineering, AACE, February, 32(2).

Revay and Assoc. "*Delay Analysis using the Snapshot Technique*", Revay and Associates Internal Documentation, 118-133.

REVAY, S.G. (1985). "*Impact Costs*", Construction Law Reports, Carswell Co. Ltd., 11, 15-26.

REVAY, S.G. (1987). "*Calculating Impact Costs*", International Business Law, October.

REVAY, S.O. (1990). "*A New Approach to Impact Costs Calculations*", Proceedings of the Project Management Institute Seminar/Symposium, Calgary, Alberta, Canada, October, 640-646.

RUBIN, R. et al, (1983). Construction Claims Analysis, Presentation, Defense, Von Nostrand Reinhold, U.S.A.

RUSKIN, A.M. and ESTES, W.E. (1992). "*Project Risk Management*", Project Management Network, PMI, April, 6(3), 30-37.

RUSSELL, J. (1990). "Surety Bonding and Owner-Contractor Prequalifications: Comparison ", Journal of Professional Issues in Engineering, ASCE, 116(4), 360-374.

SCHLEIFER, T. (1990). "*How to get paid in full and on time*", Concrete Construction, February, 237-238.

SELINGER, S. (1983). "*Payment Timing as a Factor in Bid Evaluation*", Journal of Construction Engineering and Management, ASCE, September, 109(3), 335-341.

SEY, Y. and DIKBAS, A. (1990). "*A Study on Factors Affecting Tender Price of Contractors*", Proceedings of International Symposium in Building Economics and Construction Management, CIB, Sydney, Australia, March, 451-463.

SHAFFER, L.R. and MICHEAU, T.W. (1971). "*Bidding with Competitive Strategy Models*", Journal of the Construction Division, ASCE, March, 97(CO1), 639-650.

SHASH, A.A. and ABDUL-HADI, N.H. (1992). "*Factors affecting a Contractor's Markup Size Decision in Saudi Arabia*", Journal of Construction Management and Economics, 10, 415-429.

SHASH, A.A. (1993). "*Factors Considered in Tendering Decisions by Top U.K. Contractors*", Journal Of Construction Management and Economics, 11, 111-118.

SINGH, S. (1989). "*Sensitivity Analysis of the Effect of Variables on Cash Flow for Construction Projects*", Proceedings of the Project Management Institute Seminar/Symposium, Atlanta, Georgia, Canada, October, 50-56.

SKITMORE, M. (1990). "*A Multivariate Approach to Bidding Strategies*", Proceedings of International Symposium in Building Economics and Construction Management, CIB, Sydney, Australia, March. 478-490.

TAVAKOLI, A. and UTOMO, J.J.L. (1989). "*Bid Markup Assistant*", Cost Engineering, AACE, June, 31(6), 28-33.

US Corps of Engineers, (1979). "*Modification Impact Evaluation Guide*", Department of the Army, Office of the Chief Engineers, July.

US Department of Labour, (1948). "*Hours of Work and Output*", Bureau of Labour Statistics, Bulletin 917, U.S. Government Printing Office.

WESTEINDE, J. (1988). "*Financial Risk should be shared by Contractors and Subcontractors alike*", Construction Law Letter, 4(6), Canada.

WHITE, AGEE and CASE, (1989). Principles of Engineering Economics Analysis, 3rd Ed., John Wiley and Sons, Toronto, Canada.

YATES, J.K. (1990). "*Innovative Construction Financing Techniques*", Cost Engineering, AACE, January, 32(1), 7-12.

YEO, K.T. (1990). "*Risks, Classification of Estimates and Contingency Management*", Journal of Management in Engineering, October, 6(4), 458-470.

APPENDIX A

A-1 QUANTIFICATION OF ADDED FINANCING COSTS

The contractor inputs the estimated periodic cash requirements in order to derive the total cash requirements as well as the maximum cash requirement which would be used in the loan determination calculation.

The contractor is then prompted to choose the financing scheme that he/she wishes to quantify.

SAMPLE CASE STUDY

INPUT FOLLOWING VARIABLES:

A) PERIODIC CASH REQUIRED (CRp)

1	$282,620
2	$238,980
3	$138,120
4	$231,520
5	$159,450
6	$165,210
7	$190,120
8	$164,920
9	$199,560
10	$207,700
11	$80,100
12	$80,100

CR(T) = $2,138,400
MCR = $282,620

B) FULL (F) OR PARTIAL (P) FINANCING?

C) DEFINED (D) OR CIRCUMSTANTIAL (C) REPAYMENT?

===> DF/CF/DP/CP =====>DF
PLEASE PRESS ALT-A !!!!

A-2 DEFINED FULL FINANCING

The contractor shall input the following information:

Loan Interest = *9% per annum* = *0.75% per month*

Deposit Interest = *6% per annum* = *0.50% per month*

Financing Portioning = *100%*

The payment disruptions are then performed for 1 and 2 consecutive payment periods for the established project cash flow.

SAMPLE CASE STUDY

DEFINED FULL FINANCING :

LOAN INTEREST = 9% pa = 0.75% pm

LOAN REPAYMENT = 0.0875 LRp = $24,729 per period
P(A/P i,n)

DEPOSIT INTEREST =6% pa = 0.5% pm

EARNED INTEREST = 0.005
P(F/P i,1)

LOAN DISRUPTION = 1.0075 =======> $24,915 per disrupted period
P(F/P i,n) @ 0.75%

TOTAL PAYMENT DUE
TO DISRUPTION = $49,644

==========>>>>>>>>>

SECOND LOAN DISRUPTION $25,102 $74,746

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$282,620	$18,911	$95	$19,005	$19,005
3	$138,120	$24,729	$238,980	$95,136	$476	$76,606	$95,612
4	$231,520	$24,729	$138,120	($22,518)	($113)	($118,242)	($22,630)
5	$159,450	$24,729	$231,520	$24,711	$124	$47,341	$24,711
6	$165,210	$24,729	$159,450	($5,655)	($28)	($30,489)	($5,779)
7	$190,120	$24,729	$165,210	($55,323)	($277)	($49,639)	($55,418)
8	$164,920	$24,729	$190,120	($55,128)	($276)	$471	($54,947)
9	$199,560	$24,729	$164,920	($114,773)	($574)	($59,369)	($114,316)
10	$207,700	$24,729	$199,560	($148,216)	($741)	($32,869)	($147,186)
11	$80,100	$24,729	$207,700	($46,087)	($230)	$102,871	($44,315)
12	$80,100	$24,729	$80,100	($71,046)	($355)	($24,729)	($69,044)
13		$24,729	$80,100	($16,031)	($80)	$55,371	($13,673)
		$14,131			$458		

NET INTEREST (In) = $13,673

DISTRIBUTION PROCESS :

PERIOD	CRp	Wo	Wo'	CRp'
1	$282,620	0.13	$1,807	$284,427
2	$238,980	0.11	$1,528	$240,508
3	$138,120	0.06	$883	$139,003
4	$231,520	0.11	$1,480	$233,000
5	$159,450	0.07	$1,020	$160,470
6	$165,210	0.08	$1,056	$166,266
7	$190,120	0.09	$1,216	$191,336
8	$164,920	0.08	$1,055	$165,975
9	$199,560	0.09	$1,276	$200,836
10	$207,700	0.10	$1,328	$209,028
11	$80,100	0.04	$512	$80,612
12	$80,100	0.04	$512	$80,612
		1.00	$13,673	$2,152,073

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560	$24,729	$165,975	($104,534)	($523)	($58,315)	($104,224)
10	$207,700	$24,729	$200,836	($136,650)	($683)	($31,593)	($135,818)
11	$80,100	$24,729	$209,028	($33,134)	($166)	$104,199	($31,619)
12	$80,100	$24,729	$80,612	($57,517)	($288)	($24,217)	($55,836)
13		$24,729	$80,612	($1,921)	($10)	$55,883	$47

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980			($238,980)	($1,195)	($240,175)	($240,175)
3	$138,120	$49,644	$524,935	$96,996	$485	$337,656	$97,481
4	$231,520	$24,729	$139,003	($19,765)	($99)	($117,345)	($19,864)
5	$159,450	$24,729	$233,000	$28,958	$145	$48,821	$28,958
6	$165,210	$24,729	$160,470	($367)	($2)	($29,470)	($512)
7	$190,120	$24,729	$166,266	($48,952)	($245)	($48,583)	($49,095)
8	$164,920	$24,729	$191,336	($47,510)	($238)	$1,686	($47,409)
9	$199,560	$24,729	$165,975	($106,063)	($530)	($58,315)	($105,723)
10	$207,700	$24,729	$200,836	($138,186)	($691)	($31,593)	($137,317)
11	$80,100	$24,729	$209,028	($34,678)	($173)	$104,199	($33,118)
12	$80,100	$24,729	$80,612	($59,069)	($295)	($24,217)	($57,335)
13		$24,729	$80,612	($3,481)	($17)	$55,883	($1,452)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120			($117,299)	($586)	($138,706)	($117,885)
4	$231,520	$49,644	$379,511	($19,538)	($98)	$98,250	($19,635)
5	$159,450	$24,729	$233,000	$29,186	$146	$48,821	$29,186
6	$165,210	$24,729	$160,470	($138)	($1)	($29,470)	($284)
7	$190,120	$24,729	$166,266	($48,722)	($244)	($48,583)	($48,867)
8	$164,920	$24,729	$191,336	($47,279)	($236)	$1,686	($47,180)
9	$199,560	$24,729	$165,975	($105,830)	($529)	($58,315)	($105,495)
10	$207,700	$24,729	$200,836	($137,952)	($690)	($31,593)	($137,088)
11	$80,100	$24,729	$209,028	($34,443)	($172)	$104,199	($32,890)
12	$80,100	$24,729	$80,612	($58,833)	($294)	($24,217)	($57,107)
13		$24,729	$80,612	($3,244)	($16)	$55,883	($1,224)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520			($132,547)	($663)	($232,183)	($133,210)
5	$159,450	$49,644	$372,004	$29,700	$148	$182,910	$29,700
6	$165,210	$24,729	$160,470	$378	$2	($29,470)	$230
7	$190,120	$24,729	$166,266	($48,203)	($241)	($48,583)	($48,353)
8	$164,920	$24,729	$191,336	($46,757)	($234)	$1,686	($46,667)
9	$199,560	$24,729	$165,975	($105,306)	($527)	($58,315)	($104,981)
10	$207,700	$24,729	$200,836	($137,425)	($687)	($31,593)	($136,575)
11	$80,100	$24,729	$209,028	($33,914)	($170)	$104,199	($32,376)
12	$80,100	$24,729	$80,612	($58,300)	($292)	($24,217)	($56,593)
13		$24,729	$80,612	($2,709)	($14)	$55,883	($710)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450			($177,815)	($889)	($159,450)	($177,815)
6	$165,210	$49,644	$393,470	($88)	($0)	$178,616	$801
7	$190,120	$24,729	$166,266	($48,671)	($243)	($48,583)	($47,782)
8	$164,920	$24,729	$191,336	($47,228)	($236)	$1,686	($46,095)
9	$199,560	$24,729	$165,975	($105,779)	($529)	($58,315)	($104,410)
10	$207,700	$24,729	$200,836	($137,901)	($690)	($31,593)	($136,003)
11	$80,100	$24,729	$209,028	($34,392)	($172)	$104,199	($31,804)
12	$80,100	$24,729	$80,612	($58,781)	($294)	($24,217)	($56,021)
13		$24,729	$80,612	($3,192)	($16)	$55,883	($138)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210			($134,601)	($673)	($165,210)	($134,754)
7	$190,120	$49,644	$326,736	($48,302)	($242)	$86,972	($47,782)
8	$164,920	$24,729	$191,336	($46,857)	($234)	$1,686	($46,095)
9	$199,560	$24,729	$165,975	($105,406)	($527)	($58,315)	($104,410)
10	$207,700	$24,729	$200,836	($137,527)	($688)	($31,593)	($136,003)
11	$80,100	$24,729	$209,028	($34,016)	($170)	$104,199	($31,804)
12	$80,100	$24,729	$80,612	($58,403)	($292)	($24,217)	($56,021)
13		$24,729	$80,612	($2,812)	($14)	$55,883	($138)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120			($188,975)	($945)	($190,120)	($189,133)
8	$164,920	$49,644	$357,602	($46,882)	($234)	$143,038	($46,095)
9	$199,560	$24,729	$165,975	($105,431)	($527)	($58,315)	($104,410)
10	$207,700	$24,729	$200,836	($137,552)	($688)	($31,593)	($136,003)
11	$80,100	$24,729	$209,028	($34,041)	($170)	$104,199	($31,804)
12	$80,100	$24,729	$80,612	($58,428)	($292)	($24,217)	($56,021)
13		$24,729	$80,612	($2,837)	($14)	$55,883	($138)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920			($212,595)	($1,063)	($164,920)	($212,516)
9	$199,560	$49,644	$357,310	($105,552)	($528)	$108,106	($104,410)
10	$207,700	$24,729	$200,836	($137,673)	($688)	($31,593)	($136,003)
11	$80,100	$24,729	$209,028	($34,163)	($171)	$104,199	($31,804)
12	$80,100	$24,729	$80,612	($58,551)	($293)	($24,217)	($56,021)
13		$24,729	$80,612	($2,960)	($15)	$55,883	($138)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560			($245,779)	($1,229)	($199,560)	($245,470)
10	$207,700	$49,644	$366,811	($137,541)	($688)	$109,467	($136,003)
11	$80,100	$24,729	$209,028	($34,030)	($170)	$104,199	($31,804)
12	$80,100	$24,729	$80,612	($58,417)	($292)	($24,217)	($56,021)
13		$24,729	$80,612	($2,826)	($14)	$55,883	($138)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560	$24,729	$165,975	($104,534)	($523)	($58,315)	($104,224)
10	$207,700			($312,756)	($1,564)	($207,700)	($311,924)
11	$80,100	$49,644	$409,864	($34,200)	($171)	$280,120	($31,804)
12	$80,100	$24,729	$80,612	($58,588)	($293)	($24,217)	($56,021)
13		$24,729	$80,612	($2,998)	($15)	$55,883	($138)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560	$24,729	$165,975	($104,534)	($523)	($58,315)	($104,224)
10	$207,700	$24,729	$200,836	($136,650)	($683)	($31,593)	($135,818)
11	$80,100			($217,433)	($1,087)	($80,100)	($215,918)
12	$80,100	$49,644	$289,640	($58,624)	($293)	$159,896	($56,021)
13		$24,729	$80,612	($3,034)	($15)	$55,883	($138)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560	$24,729	$165,975	($104,534)	($523)	($58,315)	($104,224)
10	$207,700	$24,729	$200,836	($136,650)	($683)	($31,593)	($135,818)
11	$80,100	$24,729	$209,028	($33,134)	($166)	$104,199	($31,619)
12	$80,100			($113,400)	($567)	($80,100)	($111,719)
13		$49,644	$161,224	($2,386)	($12)	$111,580	($138)

IDENTIFICATION OF DISRUPTION CONSEQUENCE:

2	($1,452)
3	($1,224)
4	($710)
5	($138)
6	($138)
7	($138)
8	($138)
9	($138)
10	($138)
11	($138)
12	($138)

MCF = ($1,452)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980			($238,980)	($1,195)	($240,175)	($240,175)
3	$138,120			($378,295)	($1,891)	($140,011)	($380,186)
4	$231,520	$74,746	$663,938	($22,514)	($113)	$357,560	($22,626)
5	$159,450	$24,729	$233,000	$26,195	$131	$48,821	$26,195
6	$165,210	$24,729	$160,470	($3,144)	($16)	($29,470)	($3,275)
7	$190,120	$24,729	$166,266	($51,742)	($259)	($48,583)	($51,858)
8	$164,920	$24,729	$191,336	($50,315)	($252)	$1,686	($50,171)
9	$199,560	$24,729	$165,975	($108,881)	($544)	($58,315)	($108,486)
10	$207,700	$24,729	$200,836	($141,018)	($705)	($31,593)	($140,079)
11	$80,100	$24,729	$209,028	($37,525)	($188)	$104,199	($35,880)
12	$80,100	$24,729	$80,612	($61,929)	($310)	($24,217)	($60,097)
13		$24,729	$80,612	($6,356)	($32)	$55,883	($4,214)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120			($117,299)	($586)	($138,706)	($117,885)
4	$231,520			($349,405)	($1,747)	($231,520)	($349,405)
5	$159,450	$74,746	$612,512	$27,164	$136	$378,316	$28,911
6	$165,210	$24,729	$160,470	($2,170)	($11)	($29,470)	($559)
7	$190,120	$24,729	$166,266	($50,764)	($254)	($48,583)	($49,141)
8	$164,920	$24,729	$191,336	($49,331)	($247)	$1,686	($47,455)
9	$199,560	$24,729	$165,975	($107,892)	($539)	($58,315)	($105,770)
10	$207,700	$24,729	$200,836	($140,025)	($700)	($31,593)	($137,363)
11	$80,100	$24,729	$209,028	($36,526)	($183)	$104,199	($33,164)
12	$80,100	$24,729	$80,612	($60,926)	($305)	($24,217)	($57,381)
13		$24,729	$80,612	($5,348)	($27)	$55,883	($1,498)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520			($132,547)	($663)	($231,520)	($132,547)
5	$159,450			($292,660)	($1,463)	($159,450)	($291,997)
6	$165,210	$74,746	$532,473	($1,606)	($8)	$292,518	$520
7	$190,120	$24,729	$166,266	($50,197)	($251)	($48,583)	($48,063)
8	$164,920	$24,729	$191,336	($48,761)	($244)	$1,686	($46,376)
9	$199,560	$24,729	$165,975	($107,320)	($537)	($58,315)	($104,691)
10	$207,700	$24,729	$200,836	($139,450)	($697)	($31,593)	($136,284)
11	$80,100	$24,729	$209,028	($35,948)	($180)	$104,199	($32,085)
12	$80,100	$24,729	$80,612	($60,345)	($302)	($24,217)	($56,302)
13		$24,729	$80,612	($4,764)	($24)	$55,883	($419)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450			($177,815)	($889)	($159,450)	($177,815)
6	$165,210			($343,914)	($1,720)	($165,210)	($343,025)
7	$190,120	$74,746	$559,736	($50,763)	($254)	$294,871	($48,154)
8	$164,920	$24,729	$191,336	($49,330)	($247)	$1,686	($46,468)
9	$199,560	$24,729	$165,975	($107,891)	($539)	($58,315)	($104,782)
10	$207,700	$24,729	$200,836	($140,024)	($700)	($31,593)	($136,375)
11	$80,100	$24,729	$209,028	($36,525)	($183)	$104,199	($32,177)
12	$80,100	$24,729	$80,612	($60,925)	($305)	($24,217)	($56,394)
13		$24,729	$80,612	($5,347)	($27)	$55,883	($511)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210			($134,601)	($673)	($165,210)	($134,754)
7	$190,120			($325,394)	($1,627)	($190,120)	($324,874)
8	$164,920	$74,746	$518,072	($48,615)	($243)	$278,406	($46,468)
9	$199,560	$24,729	$165,975	($107,173)	($536)	($58,315)	($104,782)
10	$207,700	$24,729	$200,836	($139,302)	($697)	($31,593)	($136,375)
11	$80,100	$24,729	$209,028	($35,800)	($179)	$104,199	($32,177)
12	$80,100	$24,729	$80,612	($60,196)	($301)	($24,217)	($56,394)
13		$24,729	$80,612	($4,614)	($23)	$55,883	($511)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120			($188,975)	($945)	($190,120)	($189,133)
8	$164,920			($354,840)	($1,774)	($164,920)	($354,053)
9	$199,560	$74,746	$523,577	($107,343)	($537)	$249,271	($104,782)
10	$207,700	$24,729	$200,836	($139,473)	($697)	($31,593)	($136,375)
11	$80,100	$24,729	$209,028	($35,972)	($180)	$104,199	($32,177)
12	$80,100	$24,729	$80,612	($60,369)	($302)	($24,217)	($56,394)
13		$24,729	$80,612	($4,788)	($24)	$55,883	($511)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920			($212,595)	($1,063)	($164,920)	($212,516)
9	$199,560			($413,218)	($2,066)	($199,560)	($412,076)
10	$207,700	$74,746	$558,146	($139,584)	($698)	$275,701	($136,375)
11	$80,100	$24,729	$209,028	($36,083)	($180)	$104,199	($32,177)
12	$80,100	$24,729	$80,612	($60,480)	($302)	($24,217)	($56,394)
13		$24,729	$80,612	($4,900)	($24)	$55,883	($511)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560			($245,779)	($1,229)	($199,560)	($245,470)
10	$207,700			($454,708)	($2,274)	($207,700)	($453,170)
11	$80,100	$74,746	$575,839	($35,988)	($180)	$420,993	($32,177)
12	$80,100	$24,729	$80,612	($60,385)	($302)	($24,217)	($56,394)
13		$24,729	$80,612	($4,804)	($24)	$55,883	($511)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560	$24,729	$165,975	($104,534)	($523)	($58,315)	($104,224)
10	$207,700			($312,756)	($1,564)	($207,700)	($311,924)
11	$80,100			($394,420)	($1,972)	($80,100)	($392,024)
12	$80,100	$74,746	$490,476	($60,761)	($304)	$335,631	($56,394)
13		$24,729	$80,612	($5,182)	($26)	$55,883	($511)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	NCF	CCF
1	$282,620		$282,620	$0	$0	$0	$0
2	$238,980	$24,729	$284,427	$20,718	$104	$20,821	$20,821
3	$138,120	$24,729	$240,508	$98,480	$492	$78,151	$98,973
4	$231,520	$24,729	$139,003	($18,273)	($91)	($117,337)	($18,365)
5	$159,450	$24,729	$233,000	$30,456	$152	$48,821	$30,456
6	$165,210	$24,729	$160,470	$1,139	$6	($29,470)	$987
7	$190,120	$24,729	$166,266	($47,438)	($237)	($48,583)	($47,596)
8	$164,920	$24,729	$191,336	($45,989)	($230)	$1,686	($45,910)
9	$199,560	$24,729	$165,975	($104,534)	($523)	($58,315)	($104,224)
10	$207,700	$24,729	$200,836	($136,650)	($683)	($31,593)	($135,818)
11	$80,100			($217,433)	($1,087)	($80,100)	($215,918)
12	$80,100			($298,620)	($1,493)	($80,100)	($296,018)
13		$74,746	$370,252	($4,606)	($23)	$295,507	($511)

IDENTIFICATION OF DISRUPTION CONSEQUENCE :

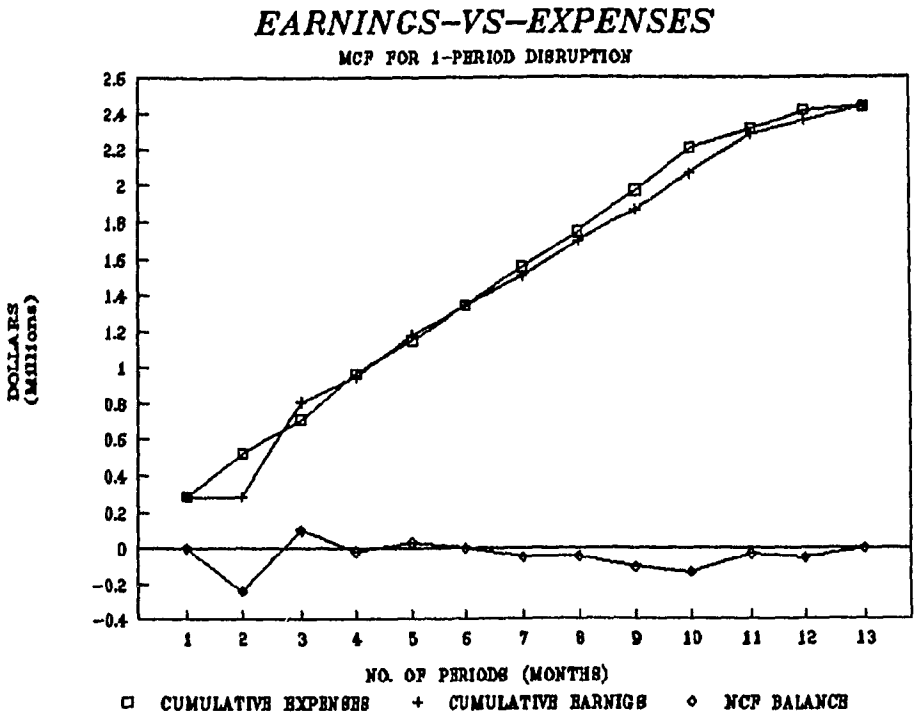
2-3	($4,214)
3-4	($1,498)
4-5	($419)
5-6	($511)
6-7	($511)
7-8	($511)
8-9	($511)
9-10	($511)
10-11	($511)
11-12	($511)

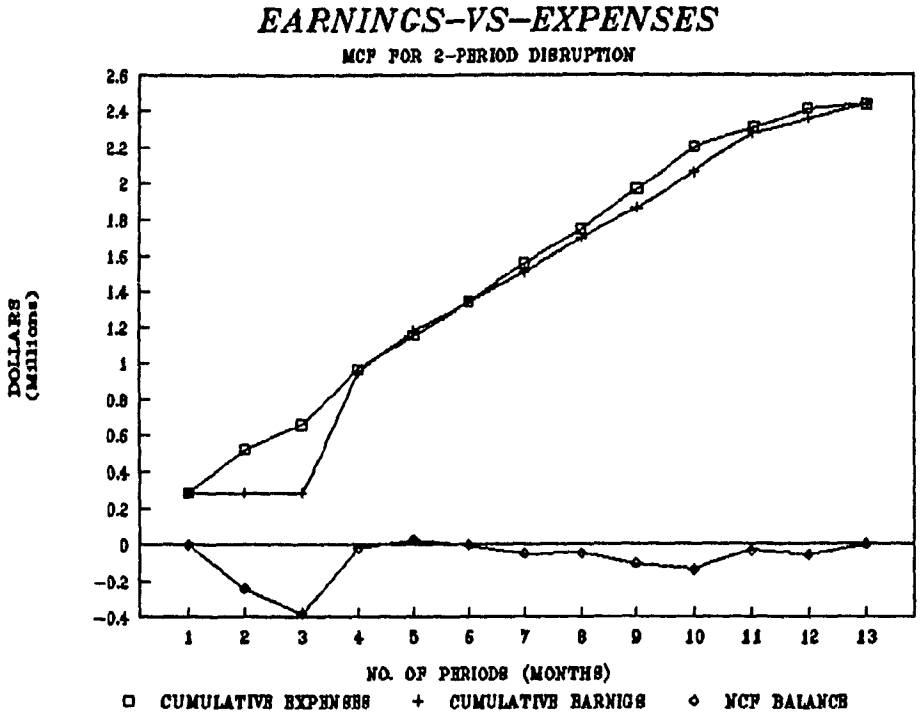
MCF = ($4,214)

SAMPLE CASE STUDY

ADDED FINANCING COSTS (Cf):

1 - PERIOD DISRUPTION =	($1,452)	0.068%
2 - PERIOD DISRUPTION =	($4,214)	0.197%


EARNINGS-VS-EXPENSES
MCF FOR 1-PERIOD DISRUPTION
DOLLARS (Millions)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1 2 3 4 5 6 7 8 9 10 11 12 13
NO. OF PERIODS (MONTHS)
□ CUMULATIVE EXPENSES + CUMULATIVE EARNIGS ◇ NCF BALANCE


EARNINGS-VS-EXPENSES
MCF FOR 2-PERIOD DISRUPTION
DOLLARS (Millions)
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1 2 3 4 5 6 7 8 9 10 11 12 13
NO. OF PERIODS (MONTHS)
□ CUMULATIVE EXPENSES + CUMULATIVE EARNIGS ◇ NCF BALANCE

A-3 DEFINED PARTIAL FINANCING

The contractor shall input the following information:

Loan Interest = *9% per annum* = *0.75% per month*

Deposit Interest = *6% per annum* = *0.50% per month*

Financing Portioning = *50%*

The payment disruptions are then performed for 1 and 2 consecutive payment periods for the established project cash flow.

SAMPLE CASE STUDY

DEFINED PARTIAL FINANCING :

PARTIAL PORTION = 50.00% LOAN = $141,310

LOAN INTEREST = 9% pa = 0.75% pm

LOAN REPAYMENT = 0.0875 LRp = $12,365 per period
P(A/P i,n)

DEPOSIT INTEREST =6% pa = 0.5% pm

EARNED INTEREST = 0.005
P(F/P i,1)

LOAN DISRUPTION = 1.0075 =======> $12,457 per disrupted period
P(F/P i,n) @ 0.75%

TOTAL PAYMENT DUE
TO DISRUPTION = $24,822

SECOND LOAN DISRUPTION = $37,373
SELF DEPOSIT INTEREST = 0.0065

==========>>>>>>>>>

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$282,620	($110,741)	($554)	$142,229	$924	$31,646	($109,452)
3	$138,120	$12,365	$238,980	($22,800)	($114)	$231,648	$1,506	$90,001	($19,451)
4	$231,520	$12,365	$138,120	($128,678)	($643)	$127,389	$828	($105,765)	($125,215)
5	$159,450	$12,365	$231,520	($69,616)	($348)	$187,923	$1,221	$59,705	($65,510)
6	$165,210	$12,365	$159,450	($88,089)	($440)	$171,020	$1,112	($18,125)	($83,635)
7	$190,120	$12,365	$165,210	($125,604)	($629)	$134,857	$877	($37,275)	($120,909)
8	$164,920	$12,365	$190,120	($113,598)	($568)	$148,569	$966	$12,835	($108,074)
9	$199,560	$12,365	$164,920	($161,170)	($806)	$102,530	$666	($47,005)	($155,079)
10	$207,700	$12,365	$199,560	($182,481)	($912)	$82,692	$537	($20,505)	($175,583)
11	$80,100	$12,365	$207,700	($68,158)	($341)	$198,464	$1,290	$115,235	($60,348)
12	$80,100	$12,365	$80,100	($80,863)	($404)	$187,390	$1,218	($12,365)	($72,712)
13		$12,365	$80,100	($13,532)	($68)	$256,343	$1,666	$67,735	($4,977)
		$7,066			($1,260)		$3,349		

NET INTEREST (In) = $4,977

DISTRIBUTION PROCESS :

PERIOD	CRp	Wo	Wo'	CRp'
1	$282,620	0.13	$658	$283,278
2	$238,980	0.11	$556	$239,536
3	$138,120	0.06	$321	$138,441
4	$231,520	0.11	$539	$232,059
5	$159,450	0.07	$371	$159,821
6	$165,210	0.08	$385	$165,595
7	$190,120	0.09	$442	$190,562
8	$164,920	0.08	$384	$165,304
9	$199,560	0.09	$464	$200,024
10	$207,700	0.10	$483	$208,183
11	$80,100	0.04	$186	$80,286
12	$80,100	0.04	$186	$80,286
		1.00	$4,977	$2,143,377

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560	$12,365	$165,304	($157,443)	($787)	$105,590	$686	($46,621)	($151,415)
10	$207,700	$12,365	$200,024	($178,270)	($891)	$86,236	$561	($20,040)	($171,455)
11	$80,100	$12,365	$208,183	($63,443)	($317)	$202,516	$1,316	$115,719	($55,737)
12	$80,100	$12,365	$80,286	($75,938)	($380)	$191,654	$1,246	($12,178)	($67,915)
13		$12,365	$80,286	($8,396)	($42)	$260,821	$1,695	$67,922	$7

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980			($380,997)	($1,905)	$142,229	$924	($239,960)	($381,059)
3	$138,120	$24,822	$522,814	($23,030)	($115)	$503,025	$3,270	$363,142	($17,917)
4	$231,520	$12,365	$138,441	($128,588)	($643)	$400,852	$2,606	($105,443)	($123,360)
5	$159,450	$12,365	$232,059	($68,987)	($345)	$463,701	$3,014	$60,244	($63,116)
6	$165,210	$12,365	$159,821	($87,085)	($435)	$448,962	$2,918	($17,754)	($80,869)
7	$190,120	$12,365	$165,595	($124,411)	($622)	$414,990	$2,697	($36,890)	($117,759)
8	$164,920	$12,365	$190,562	($111,755)	($559)	$430,965	$2,801	$13,278	($104,482)
9	$199,560	$12,365	$165,304	($158,934)	($795)	$387,146	$2,516	($46,621)	($151,102)
10	$207,700	$12,365	$200,024	($179,769)	($899)	$369,622	$2,403	($20,040)	($171,142)
11	$80,100	$12,365	$208,183	($64,949)	($325)	$487,743	$3,170	$115,719	($55,424)
12	$80,100	$12,365	$80,286	($77,452)	($387)	$478,736	$3,112	($12,178)	($67,602)
13		$12,365	$80,286	($9,918)	($50)	$549,769	$3,573	$67,922	$320

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120			($248,754)	($1,244)	$5,033	$33	($138,120)	($246,911)
4	$231,520	$24,822	$377,978	($128,362)	($642)	$126,701	$824	$121,636	($125,275)
5	$159,450	$12,365	$232,059	($68,759)	($344)	$187,769	$1,220	$60,244	($65,031)
6	$165,210	$12,365	$159,821	($86,857)	($434)	$171,236	$1,113	($17,754)	($82,784)
7	$190,120	$12,365	$165,595	($124,181)	($621)	$135,459	$880	($36,890)	($119,674)
8	$164,920	$12,365	$190,562	($111,524)	($558)	$149,617	$973	$13,278	($106,397)
9	$199,560	$12,365	$165,304	($158,703)	($794)	$103,969	$676	($46,621)	($153,017)
10	$207,700	$12,365	$200,024	($179,536)	($898)	$84,605	$550	($20,040)	($173,058)
11	$80,100	$12,365	$208,183	($64,715)	($324)	$200,874	$1,306	$115,719	($57,339)
12	$80,100	$12,365	$80,286	($77,217)	($386)	$190,001	$1,235	($12,178)	($69,517)
13		$12,365	$80,286	($9,681)	($48)	$259,158	$1,685	$67,922	($1,595)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520			($253,210)	($1,266)	$2,194	$14	($231,520)	($249,750)
5	$159,450	$24,822	$370,500	($68,248)	($341)	$188,437	$1,225	$186,228	($63,522)
6	$165,210	$12,365	$159,821	($86,343)	($432)	$171,908	$1,117	($17,754)	($81,275)
7	$190,120	$12,365	$165,595	($123,664)	($618)	$136,135	$885	($36,890)	($118,165)
8	$164,920	$12,365	$190,562	($111,005)	($555)	$150,298	$977	$13,278	($104,887)
9	$199,560	$12,365	$165,304	($158,181)	($791)	$104,654	$680	($46,621)	($151,508)
10	$207,700	$12,365	$200,024	($179,012)	($895)	$85,294	$554	($20,040)	($171,548)
11	$80,100	$12,365	$208,183	($64,188)	($321)	$201,567	$1,310	$115,719	($55,829)
12	$80,100	$12,365	$80,286	($76,687)	($383)	$190,699	$1,240	($12,178)	($68,008)
13		$12,365	$80,286	($9,149)	($46)	$259,861	$1,689	$67,922	($86)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450			($287,219)	($1,436)	($30,345)	($197)	($159,450)	($283,123)
6	$165,210	$24,822	$391,880	($86,807)	($434)	$171,305	$1,113	$201,848	($81,275)
7	$190,120	$12,365	$165,595	($124,131)	($621)	$135,529	$881	($36,890)	($118,165)
8	$164,920	$12,365	$190,062	($111,474)	($557)	$149,687	$973	$13,278	($104,887)
9	$199,560	$12,365	$165,304	($158,652)	($793)	$104,040	$676	($46,621)	($151,508)
10	$207,700	$12,365	$200,024	($179,486)	($897)	$84,676	$550	($20,040)	($171,548)
11	$80,100	$12,365	$208,183	($64,664)	($323)	$200,945	$1,306	$115,719	($55,829)
12	$80,100	$12,365	$80,286	($77,166)	($386)	$190,073	$1,235	($12,178)	($68,008)
13		$12,365	$80,286	($9,630)	($48)	$259,230	$1,685	$67,922	($86)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210			($233,072)	($1,165)	$25,370	$165	($165,210)	($228,639)
7	$190,120	$24,822	$325,416	($123,764)	($619)	$136,008	$884	$110,474	($118,165)
8	$164,920	$12,365	$190,562	($111,105)	($556)	$150,170	$976	$13,278	($104,887)
9	$199,560	$12,365	$165,304	($158,281)	($791)	$104,525	$679	($46,621)	($151,508)
10	$207,700	$12,365	$200,024	($179,113)	($896)	$85,165	$554	($20,040)	($171,548)
11	$80,100	$12,365	$208,183	($64,290)	($321)	$201,437	$1,309	$115,719	($55,829)
12	$80,100	$12,365	$80,286	($76,789)	($384)	$190,568	$1,239	($12,178)	($68,008)
13		$12,365	$80,286	($9,251)	($46)	$259,729	$1,688	$67,922	($86)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120			($276,164)	($1,381)	($18,171)	($105)	($190,120)	($271,302)
8	$164,920	$24,822	$356,157	($111,130)	($556)	$150,139	$976	$166,415	($104,887)
9	$199,560	$12,365	$165,304	($158,306)	($792)	$104,494	$679	($48,621)	($153,508)
10	$207,700	$12,365	$200,024	($179,138)	($896)	$85,133	$553	($20,040)	($171,548)
11	$80,100	$12,365	$208,183	($64,315)	($322)	$201,406	$1,309	$115,719	($55,829)
12	$80,100	$12,365	$80,286	($76,815)	($384)	$190,537	$1,238	($12,178)	($68,008)
13		$12,365	$80,286	($9,277)	($46)	$259,697	$1,688	$67,922	($86)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920			($288,469)	($1,442)	($26,970)	($175)	($164,920)	($282,992)
9	$199,560	$24,822	$355,866	($158,427)	($792)	$104,339	$678	$131,484	($151,508)
10	$207,700	$12,365	$200,024	($179,259)	($896)	$84,977	$552	($20,040)	($171,548)
11	$80,100	$12,365	$208,183	($64,436)	($322)	$201,248	$1,308	$115,719	($55,829)
12	$80,100	$12,365	$80,286	($76,937)	($385)	$190,378	$1,237	($12,178)	($68,008)
13		$12,365	$80,286	($9,400)	($47)	$259,538	$1,687	$67,922	($86)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560			($310,382)	($1,552)	($47,349)	($308)	($199,560)	($304,355)
10	$207,700	$24,822	$365,328	($179,128)	($896)	$85,150	$553	$132,806	($171,548)
11	$80,100	$12,365	$208,183	($64,305)	($322)	$201,422	$1,309	$115,719	($55,829)
12	$80,100	$12,365	$80,286	($76,804)	($384)	$190,553	$1,239	($12,178)	($68,008)
13		$12,365	$80,286	($9,267)	($46)	$259,713	$1,688	$67,922	($86)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560	$12,365	$165,304	($157,443)	($787)	$105,590	$686	($46,621)	($151,415)
10	$207,700			($365,930)	($1,830)	($101,423)	($659)	($207,700)	($359,115)
11	$80,100	$24,822	$408,208	($64,474)	($322)	$201,203	$1,308	$303,286	($55,829)
12	$80,100	$12,365	$80,286	($76,975)	($385)	$190,333	$1,237	($12,178)	($68,008)
13		$12,365	$80,286	($9,438)	($47)	$259,492	$1,687	$67,922	($86)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560	$12,365	$165,304	($157,443)	($787)	$105,590	$686	($46,621)	($151,415)
10	$207,700	$12,365	$200,024	($178,270)	($891)	$86,236	$561	($20,040)	($171,455)
11	$80,100			($259,262)	($1,296)	$6,697	$44	($80,100)	($251,555)
12	$80,100	$24,822	$288,470	($77,010)	($385)	$190,288	$1,237	$183,548	($68,008)
13		$12,365	$80,286	($9,473)	($47)	$259,447	$1,686	$67,922	($86)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560	$12,365	$165,304	($157,443)	($787)	$105,590	$686	($46,621)	($151,415)
10	$207,700	$12,365	$200,024	($178,270)	($891)	$86,236	$561	($20,040)	($171,455)
11	$80,100	$12,365	$208,163	($63,443)	($317)	$202,516	$1,316	$115,719	($55,737)
12	$80,100			($143,860)	($719)	$123,732	$804	($80,100)	($135,837)
13		$24,822	$160,573	($8,829)	($44)	$260,287	$1,692	$135,751	($86)

IDENTIFICATION OF DISRUPTION CONSEQUENCES :

2	$320
3	($1,595)
4	($86)
5	($86)
6	($86)
7	($86)
8	($86)
9	($86)
10	($86)
11	($86)
12	($86)

MCF = ($1,595)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980			($380,997)	($1,905)	$142,229	$924	($239,960)	($381,059)
3	$138,120			($521,022)	($2,605)	$5,033	$33	($138,120)	($519,179)
4	$231,520	$37,373	$661,255	($131,264)	($656)	$397,428	$2,583	$392,363	($126,816)
5	$159,450	$12,365	$232,059	($71,676)	($358)	$460,256	$2,992	$60,244	($66,572)
6	$165,210	$12,365	$159,821	($89,788)	($449)	$445,494	$2,896	($17,754)	($84,325)
7	$190,120	$12,365	$165,595	($127,127)	($636)	$411,500	$2,675	($36,890)	($121,215)
8	$164,920	$12,365	$190,562	($114,485)	($572)	$427,452	$2,778	$13,278	($107,937)
9	$199,560	$12,365	$165,304	($161,678)	($808)	$383,610	$2,493	($46,621)	($154,558)
10	$207,700	$12,365	$200,024	($182,526)	($913)	$366,063	$2,379	($20,040)	($174,598)
11	$80,100	$12,365	$208,183	($67,720)	($339)	$484,161	$3,147	$115,719	($58,880)
12	$80,100	$12,365	$80,286	($80,237)	($401)	$475,130	$3,088	($12,178)	($71,058)
13		$12,365	$80,286	($12,717)	($64)	$546,140	$3,550	$67,922	($3,136)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120			($248,754)	($1,244)	$5,033	$33	($138,120)	($246,911)
4	$231,520			($481,518)	($2,408)	($226,454)	($1,472)	($231,520)	($478,431)
5	$159,450	$37,373	$610,037	($70,711)	($354)	$185,288	$1,204	$413,214	($65,217)
6	$165,210	$12,365	$159,821	($88,818)	($444)	$168,738	$1,097	($17,754)	($82,971)
7	$190,120	$12,365	$165,595	($126,153)	($631)	$132,945	$864	($36,890)	($119,861)
8	$164,920	$12,365	$190,562	($113,506)	($568)	$147,087	$956	$13,278	($106,583)
9	$199,560	$12,365	$165,304	($160,694)	($803)	$101,422	$659	($46,621)	($153,204)
10	$207,700	$12,365	$200,024	($181,537)	($908)	$82,041	$533	($20,040)	($173,244)
11	$80,100	$12,365	$208,183	($66,726)	($334)	$198,294	$1,289	$115,719	($57,525)
12	$80,100	$12,365	$80,286	($79,238)	($396)	$187,404	$1,218	($12,178)	($69,703)
13		$12,365	$80,286	($11,713)	($59)	$256,544	$1,668	$67,922	($1,781)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520			($253,210)	($1,266)	$2,194	$14	($231,520)	($249,750)
5	$159,450			($413,926)	($2,070)	($157,242)	($1,022)	($159,450)	($409,200)
6	$165,210	$37,373	$530,321	($88,257)	($441)	$169,475	$1,102	$327,739	($81,461)
7	$190,120	$12,365	$165,595	($125,589)	($628)	$133,686	$869	($36,890)	($118,351)
8	$164,920	$12,365	$190,562	($112,939)	($565)	$147,833	$961	$13,278	($105,073)
9	$199,560	$12,365	$165,304	($160,124)	($801)	$102,173	$664	($46,821)	($151,694)
10	$207,700	$12,365	$200,024	($180,965)	($905)	$82,797	$538	($20,040)	($171,734)
11	$80,100	$12,365	$208,183	($66,151)	($331)	$199,054	$1,294	$115,719	($56,016)
12	$80,100	$12,365	$80,286	($78,660)	($393)	$188,170	$1,223	($12,178)	($68,194)
13		$12,365	$80,286	($11,131)	($56)	$257,315	$1,673	$67,922	($272)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450			($287,219)	($1,436)	($30,345)	($197)	($159,450)	($283,123)
6	$165,210			($453,865)	($2,269)	($195,753)	($1,272)	($165,210)	($448,333)
7	$190,120	$37,373	$557,474	($126,153)	($631)	$132,957	$864	$329,982	($118,351)
8	$164,920	$12,365	$190,562	($113,506)	($568)	$147,099	$956	$13,278	($105,073)
9	$199,560	$12,365	$165,304	($160,694)	($803)	$101,434	$659	($46,621)	($151,694)
10	$207,700	$12,365	$200,024	($181,537)	($908)	$82,053	$533	($20,040)	($171,734)
11	$80,100	$12,365	$208,183	($66,726)	($334)	$198,305	$1,289	$115,719	($56,016)
12	$80,100	$12,365	$80,286	($79,238)	($396)	$187,416	$1,218	($12,178)	($68,194)
13		$12,365	$80,286	($11,713)	($59)	$256,556	$1,668	$67,922	($272)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210			($233,072)	($1,165)	$25,370	$165	($165,210)	($228,639)
7	$190,120			($424,358)	($2,122)	($164,586)	($1,070)	($190,120)	($418,759)
8	$164,920	$37,373	$515,978	($112,794)	($564)	$148,030	$962	$313,685	($105,073)
9	$199,560	$12,365	$165,304	($159,979)	($800)	$102,371	$665	($46,621)	($151,694)
10	$207,700	$12,365	$200,024	($180,819)	($904)	$82,997	$539	($20,040)	($171,734)
11	$80,100	$12,365	$208,183	($66,004)	($330)	$199,255	$1,295	$115,719	($56,016)
12	$80,100	$12,365	$80,286	($78,512)	($393)	$188,372	$1,224	($12,178)	($68,194)
13		$12,365	$80,286	($10,983)	($55)	$257,518	$1,674	$67,922	($272)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120			($276,164)	($1,381)	($16,171)	($105)	($190,120)	($271,302)
8	$164,920			($442,465)	($2,212)	($181,196)	($1,178)	($164,920)	($436,222)
9	$199,560	$37,373	$521,461	($160,149)	($801)	$102,155	$664	$284,528	($151,694)
10	$207,700	$12,365	$200,024	($180,990)	($905)	$82,778	$538	($20,040)	($171,734)
11	$80,100	$12,365	$208,183	($66,176)	($331)	$199,035	$1,294	$115,719	($56,016)
12	$80,100	$12,365	$80,286	($78,685)	($393)	$188,151	$1,223	($12,178)	($68,194)
13		$12,365	$80,286	($11,157)	($56)	$257,296	$1,672	$67,922	($272)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920			($288,469)	($1,442)	($26,970)	($175)	($164,920)	($282,992)
9	$199,560			($489,471)	($2,447)	($226,705)	($1,474)	($199,560)	($482,552)
10	$207,700	$37,373	$555,891	($181,100)	($906)	$82,639	$537	$310,818	($171,734)
11	$80,100	$12,365	$208,183	($66,287)	($331)	$198,895	$1,293	$115,719	($56,016)
12	$80,100	$12,365	$80,286	($78,797)	($394)	$188,010	$1,222	($12,178)	($68,194)
13		$12,365	$80,286	($11,269)	($56)	$257,154	$1,671	$67,922	($272)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560			($310,382)	($1,552)	($47,349)	($308)	($199,560)	($304,355)
10	$207,700			($519,634)	($2,598)	($255,357)	($1,660)	($207,700)	($512,055)
11	$80,100	$37,373	$573,512	($66,193)	($331)	$199,022	$1,294	$456,039	($56,016)
12	$80,100	$12,365	$80,286	($78,702)	($394)	$188,138	$1,223	($12,178)	($68,194)
13		$12,365	$80,286	($11,174)	($56)	$257,283	$1,672	$67,922	($272)

SAMPLE CASE STUDY

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560	$12,365	$165,304	($157,443)	($787)	$105,590	$686	($46,621)	($151,415)
10	$207,700			($365,930)	($1,830)	($101,423)	($659)	($207,700)	($359,115)
11	$80,100			($447,860)	($2,239)	($182,183)	($1,184)	($80,100)	($439,215)
12	$80,100	$37,373	$488,494	($79,078)	($395)	$187,655	$1,220	$371,022	($68,194)
13		$12,365	$80,286	($11,551)	($58)	$256,796	$1,669	$67,922	($272)

PERIOD	CRp	LRp	Pi	DEP.BAL	Id	SELF.BAL	Ids	NCF	CCF
1	$282,620		$141,310	($141,310)	($707)	$141,310	$919	($141,098)	($141,098)
2	$238,980	$12,365	$283,278	($110,083)	($550)	$142,229	$924	$32,307	($108,791)
3	$138,120	$12,365	$239,536	($21,582)	($108)	$232,205	$1,509	$90,561	($18,230)
4	$231,520	$12,365	$138,441	($127,133)	($636)	$128,271	$834	($105,443)	($123,673)
5	$159,450	$12,365	$232,059	($67,525)	($338)	$189,349	$1,231	$60,244	($63,429)
6	$165,210	$12,365	$159,821	($85,616)	($428)	$172,826	$1,123	($17,754)	($81,182)
7	$190,120	$12,365	$165,595	($122,934)	($615)	$137,059	$891	($36,890)	($118,072)
8	$164,920	$12,365	$190,562	($110,271)	($551)	$151,228	$983	$13,278	($104,795)
9	$199,560	$12,365	$165,304	($157,443)	($787)	$105,590	$686	($46,621)	($151,415)
10	$207,700	$12,365	$200,024	($178,270)	($891)	$86,236	$561	($20,040)	($171,455)
11	$80,100			($259,262)	($1,296)	$6,697	$44	($80,100)	($251,555)
12	$80,100			($340,658)	($1,703)	($73,360)	($477)	($80,100)	($331,655)
13		$37,373	$368,756	($10,978)	($55)	$257,547	$1,674	$331,383	($272)

IDENTIFICATION OF DISRUPTION COSEQUENCE :

2-3	($3,136)
3-4	($1,781)
4-5	($272)
5-6	($272)
6-7	($272)
7-8	($272)
8-9	($272)
9-10	($272)
10-11	($272)
11-12	($272)

MCF = ($3,136)

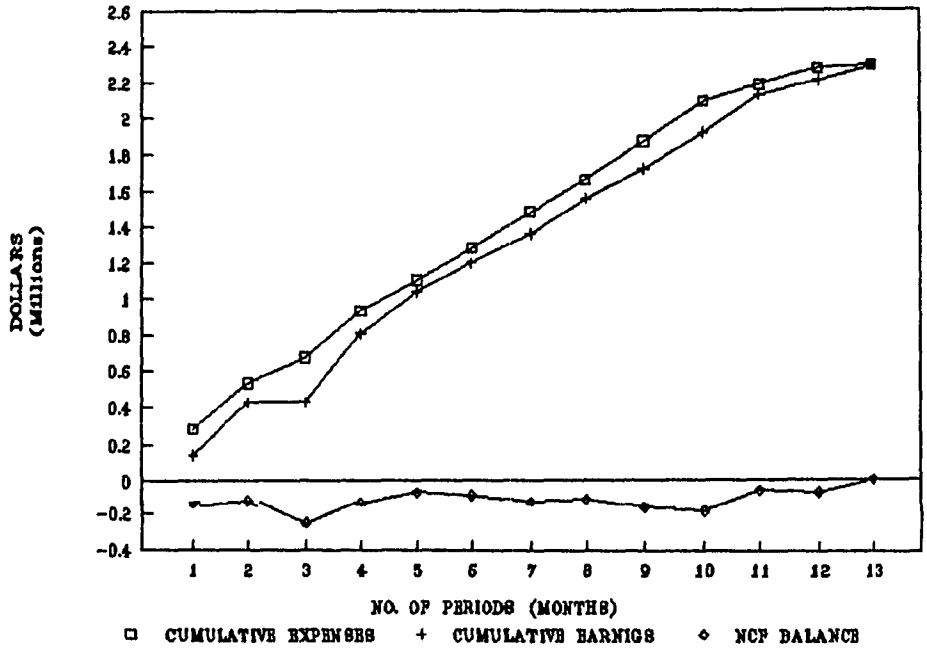
SAMPLE CASE STUDY

ADDED FINANCING COSTS (Cf):

1 - PERIOD DISRUPTION =	($1,595)	0.075%
2 - PERIOD DISRUPTION =	($3,136)	0.147%

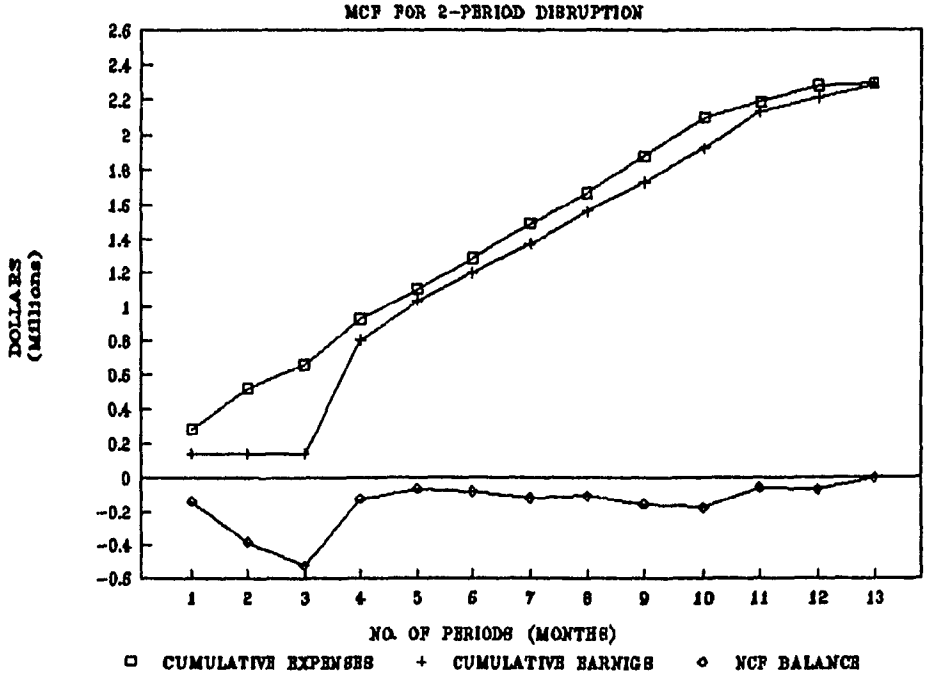
EARNINGS–VS–EXPENSES

MCF FOR 1-PERIOD DISRUPTION



EARNINGS–VS–EXPENSES

MCF FOR 2-PERIOD DISRUPTION



A-4 CIRCUMSTANTIAL FULL FINANCING

The contractor shall input the following information:

Loan Interest = 9% per annum = 0.75% per month

Deposit Interest = 6% per annum = 0.50% per month

Financing Portioning = 100%

Unused Credit Commission Fee factor = 0.0025.

The payment disruptions are then performed for 1 and 2 consecutive payment periods for the established project cash flow.

CIRCUMSTANTIAL FULL FINANCING :

LOAN INTEREST : 9% pa = 0.75% pm 0.75%

UNUSED COMMISSION (F) = 0.0025

LOAN DISRUPTION = 1.0075
P(F/P i,n) @ 0.75%

SECOND LOAN DISRUPTION= 1.0151

SAMPLE CASE STUDY

PERIOD	CRp	P1	LRp	F	NCF	CCF	Ac
1	$282,620	$282,620			$0	$0	
2	$238,980	$282,620	$284,740	$0	($241,100)	($241,100)	($241,100)
3	$138,120	$238,980	$240,772	$109	($140,021)	($381,121)	($140,021)
4	$231,520	$138,120	$139,156	$361	($232,917)	($614,038)	($232,917)
5	$159,450	$231,520	$233,256	$128	($161,314)	($775,352)	($161,314)
6	$165,210	$159,450	$160,646	$308	($166,714)	($942,066)	($166,714)
7	$190,120	$165,210	$166,449	$294	($191,653)	($1,133,719)	($191,653)
8	$164,920	$190,120	$191,546	$231	($166,577)	($1,300,296)	($166,577)
9	$199,560	$164,920	$166,157	$294	($201,091)	($1,501,387)	($201,091)
10	$207,700	$199,560	$201,057	$208	($209,404)	($1,710,791)	($209,404)
11	$80,100	$207,700	$209,258	$187	($81,845)	($1,792,637)	($81,845)
12	$80,100	$80,100	$80,701	$506	($81,207)	($1,873,844)	($81,207)
13		$80,100	$80,701	$506	($1,107)	($1,874,951)	($1,107)
			$16,038	$3,133		($19,171)	

NET INTEREST (In) = $19,171

DISTRIBUTION PROCESS :

PERIOD	CRp	Wo	Wo'	CRp'
1	$282,620	0.13	$2,534	$285,154
2	$238,980	0.11	$2,142	$241,122
3	$138,120	0.06	$1,238	$139,358
4	$231,520	0.11	$2,076	$233,596
5	$159,450	0.07	$1,429	$160,879
6	$165,210	0.08	$1,481	$166,691
7	$190,120	0.09	$1,704	$191,824
8	$164,920	0.08	$1,478	$166,398
9	$199,560	0.09	$1,789	$201,349
10	$207,700	0.10	$1,862	$209,562
11	$80,100	0.04	$718	$80,818
12	$80,100	0.04	$718	$80,818
		1.00	$19,171	$2,157,571

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF
1	$282,620	$282,620			$0	$0
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,487,304)
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,694,919)
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,774,902)
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,855,391)
13		$80,818	$80,701	$506	($389)	($1,855,780)
						$0

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980				($238,980)	($238,980)	
3	$138,120	$526,276	$527,648	$0	($139,491)	($378,471)	($597)
4	$231,520	$139,358	$139,156	$361	($231,679)	($610,150)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($769,389)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($934,673)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,124,845)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,289,718)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,489,330)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,696,945)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,776,929)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,857,417)	
13		$80,818	$80,701	$506	($389)	($1,857,806)	
						($2,026)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120				($138,120)	($376,686)	
4	$231,520	$380,481	$381,734	$0	($232,773)	($609,459)	($127)
5	$159,450	$233,596	$233,256	$128	($159,239)	($768,698)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($933,982)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,124,154)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,289,027)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,488,639)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,696,254)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,776,238)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,726)	
13		$80,818	$80,701	$506	($389)	($1,857,115)	
						($1,335)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520				($231,520)	($607,965)	
5	$159,450	$372,954	$373,456	$144	($160,096)	($768,061)	$144
6	$165,210	$160,879	$160,646	$308	($165,284)	($933,345)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,123,517)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,288,389)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,488,002)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,695,617)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,775,600)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,089)	
13		$80,818	$80,701	$506	($389)	($1,856,478)	
						($698)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450				($159,450)	($767,574)	
6	$165,210	$394,475	$395,652	$0	($166,387)	($933,961)	($143)
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,124,132)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,289,005)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,488,617)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,696,233)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,776,216)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,705)	
13		$80,818	$80,701	$506	($389)	($1,857,094)	
						($1,314)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210				($165,210)	($932,572)	
7	$190,120	$327,571	$328,300	$203	($191,052)	($1,123,625)	$203
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,288,497)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,488,110)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,695,725)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,775,708)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,197)	
13		$80,818	$80,701	$506	($389)	($1,856,586)	
						($806)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120				($190,120)	($1,122,767)	
8	$164,920	$358,516	$359,243	$112	($165,760)	($1,288,526)	$112
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,488,139)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,695,754)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,775,737)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,226)	
13		$80,818	$80,701	$506	($389)	($1,856,615)	
						($835)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920				($164,920)	($1,287,738)	
9	$199,560	$358,223	$359,139	$50	($200,527)	($1,488,265)	$50
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,695,880)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,775,863)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,352)	
13		$80,818	$80,701	$506	($389)	($1,856,741)	
						($961)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560				($199,560)	($1,487,251)	
10	$207,700	$367,748	$368,460	$90	($208,502)	($1,695,753)	$90
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,775,736)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,225)	
13		$80,818	$80,701	$506	($389)	($1,856,614)	
						($834)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,487,304)	
10	$207,700				($207,700)	($1,695,004)	
11	$80,100	$410,911	$411,822	$0	($81,011)	($1,776,015)	($104)
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,856,504)	
13		$80,818	$80,701	$506	($389)	($1,856,893)	
						($1,113)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,487,304)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,694,919)	
11	$80,100				($80,100)	($1,775,019)	
12	$80,100	$290,380	$291,528	$174	($81,422)	($1,856,441)	$174
13		$80,818	$80,701	$506	($389)	($1,856,830)	
						($1,050)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,487,304)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,694,919)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,774,902)	
12	$80,100				($80,100)	($1,855,002)	
13		$161,636	$162,007	$812	($1,183)	($1,856,185)	$812
						($405)	

IDENTIFICATION OF DISRUPTION CONSEQUENCE :

2	($2,026)
3	($1,335)
4	($698)
5	($1,314)
6	($806)
7	($835)
8	($961)
9	($834)
10	($1,113)
11	($1,050)
12	($405)

NCF = ($2,026)

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980				($238,980)	($238,980)	
3	$138,120				($138,120)	($377,100)	
4	$231,520	$665,634	$670,773	$0	($236,659)	($613,759)	($1,540)
5	$159,450	$233,596	$233,256	$128	($159,239)	($772,998)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($938,282)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,128,453)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,293,326)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,492,939)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,700,554)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,780,537)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,861,026)	
13		$80,818	$80,701	$506	($389)	($1,861,415)	
						($5,635)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120				($138,120)	($376,686)	
4	$231,520				($231,520)	($608,206)	
5	$159,450	$614,078	$617,864	$0	($163,238)	($771,444)	($942)
6	$165,210	$160,879	$160,646	$308	($165,284)	($936,728)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,126,900)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,291,772)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,491,385)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,699,000)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,778,983)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,859,472)	
13		$80,818	$80,701	$506	($389)	($1,859,861)	
						($4,081)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520				($231,520)	($607,965)	
5	$159,450				($159,450)	($767,415)	
6	$165,210	$533,833	$536,909	$0	($168,286)	($935,701)	($472)
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,125,872)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,290,745)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,490,357)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,697,973)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,777,956)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,858,445)	
13		$80,818	$80,701	$506	($389)	($1,858,834)	
						($3,054)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$381	($231,679)	($608,124)	
5	$159,450				($159,450)	($767,574)	
6	$165,210				($165,210)	($932,784)	
7	$190,120	$561,166	$565,078	$0	($194,032)	($1,126,816)	($827)
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,291,689)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,491,302)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,698,917)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,778,900)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,859,389)	
13		$80,818	$80,701	$506	($389)	($1,859,778)	
						($3,998)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210				($165,210)	($932,572)	
7	$190,120				($190,120)	($1,122,692)	
8	$164,920	$519,395	$522,315	$0	($167,840)	($1,290,533)	($378)
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,490,145)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,697,760)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,777,744)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,858,232)	
13		$80,818	$80,701	$506	($389)	($1,858,621)	
						($2,841)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120				($190,120)	($1,122,767)	
8	$164,920				($164,920)	($1,287,687)	
9	$199,560	$524,914	$528,102	$0	($202,748)	($1,490,435)	($482)
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,698,050)	
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,778,033)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,858,522)	
13		$80,818	$80,701	$506	($389)	($1,858,911)	
						($3,131)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920				($164,920)	($1,287,738)	
9	$199,560				($199,560)	($1,487,298)	
10	$207,700	$559,572	$562,898	$0	($211,026)	($1,698,324)	($630)
11	$80,100	$209,562	$209,258	$187	($79,983)	($1,778,307)	
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,858,796)	
13		$80,818	$80,701	$506	($389)	($1,859,185)	
						($3,405)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560				($199,560)	($1,487,251)	
10	$207,700				($207,700)	($1,694,951)	
11	$80,100	$577,310	$580,488	$0	($83,279)	($1,778,230)	($634)
12	$80,100	$80,818	$80,701	$506	($80,489)	($1,858,719)	
13		$80,818	$80,701	$506	($389)	($1,859,108)	
						($3,328)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,487,304)	
10	$207,700				($207,700)	($1,695,004)	
11	$80,100				($80,100)	($1,775,104)	
12	$80,100	$491,729	$495,621	$0	($83,991)	($1,859,095)	($616)
13		$80,818	$80,701	$506	($389)	($1,859,484)	
						($3,704)	

PERIOD	CRp	Pi	LRp	F	NCF	CCF	
1	$282,620	$282,620			$0	$0	
2	$238,980	$285,154	$284,740	$0	($238,566)	($238,566)	
3	$138,120	$241,122	$240,772	$109	($137,879)	($376,445)	
4	$231,520	$139,358	$139,156	$361	($231,679)	($608,124)	
5	$159,450	$233,596	$233,256	$128	($159,239)	($767,362)	
6	$165,210	$160,879	$160,646	$308	($165,284)	($932,647)	
7	$190,120	$166,691	$166,449	$294	($190,172)	($1,122,818)	
8	$164,920	$191,824	$191,546	$231	($164,873)	($1,287,691)	
9	$199,560	$166,398	$166,157	$294	($199,613)	($1,487,304)	
10	$207,700	$201,349	$201,057	$208	($207,615)	($1,694,919)	
11	$80,100				($80,100)	($1,775,019)	
12	$80,100				($80,100)	($1,855,119)	
13		$371,198	$374,424	$0	($3,226)	($1,858,345)	($39)
						($2,565)	

IDENTIFICATION OF DISRUPTION CONSEQUENCE :

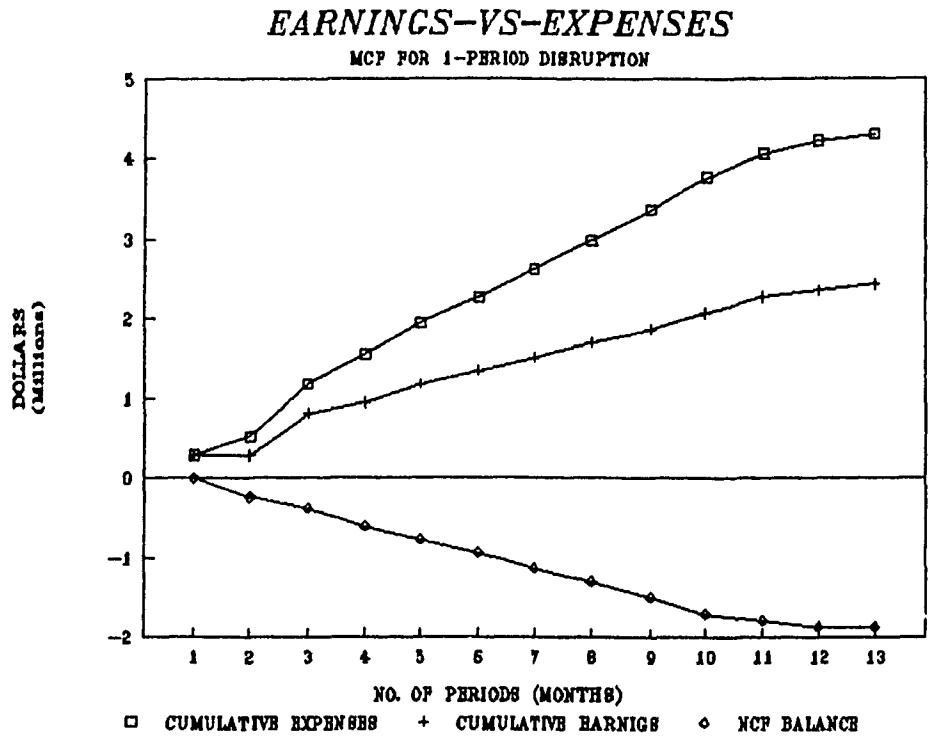
2-3	($5,635)
3-4	($4,081)
4-5	($3,054)
[illegible]-6	($3,998)
6-7	($2,841)
7-8	($3,131)
8-9	($3,405)
9-10	($3,328)
10-11	($3,704)
11-12	($2,565)

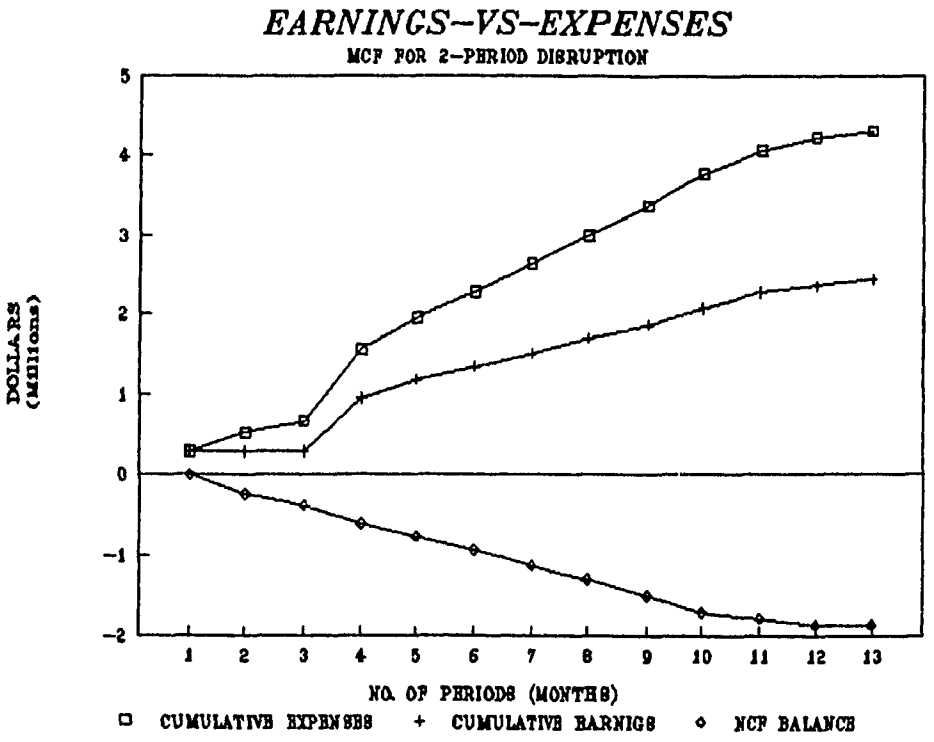
MCF = ($5,635)

SAMPLE CASE STUDY

ADDED FINANCING COSTS (Cf):

1 - PERIOD DISRUPTION =	($2,026)	0.095%
2 - PERIOD DISRUPTION =	($5,635)	0.264%


EARNINGS–VS–EXPENSES
MCF FOR 1–PERIOD DISRUPTION
DOLLARS (Millions)
5
4
3
2
1
0
–1
–2
1 2 3 4 5 6 7 8 9 10 11 12 13
NO. OF PERIODS (MONTHS)
□ CUMULATIVE EXPENSES + CUMULATIVE EARNIGS ◇ NCF BALANCE


EARNINGS–VS–EXPENSES
MCF FOR 2–PERIOD DISRUPTION
DOLLARS (Millions)
5
4
3
2
1
0
–1
–2
1 2 3 4 5 6 7 8 9 10 11 12 13
NO. OF PERIODS (MONTHS)
□ CUMULATIVE EXPENSES + CUMULATIVE EARNIGS ◇ NCF BALANCE

A-5 CIRCUMSTANTIAL PARTIAL FINANCING

The contractor shall input the following information:

Loan Interest = 9% per annum = 0 75% per month

Deposit Interest = 6% per annum = 0.50% per month

Financing Portioning = 50%

Unused Credit Commission Fee factor = 0.0025.

The payment disruptions are then performed for 1 and 2 consecutive payment periods for the established project cash flow.

CIRCUMSTANTIAL PARTIAL FINANCING :

PARTIAL PORTION = 50.00% LOAN = $141,310

LOAN INTEREST = 9% pa = 0.75% pm 0.75%

LOAN DISRUPTION = 1.0075
P(F/P i,n) @ 0.75%

SELF DEPOSIT INTEREST = 0.0065

UNUSED COMMISSION (F) = 0.0025

SECOND LOAN DISRUPTION = 1.0151

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	Ac
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$282,620	$284,740	$0	($98,871)	($643)	($241,742)	($382,134)	($241,100)
3	$138,120	$238,980	$240,772	$109	($239,535)	($1,557)	($140,021)	($522,155)	($140,021)
4	$231,520	$138,120	$139,156	$361	($474,009)	($3,081)	($232,917)	($755,072)	($232,917)
5	$159,450	$231,520	$233,256	$128	($638,405)	($4,150)	($161,314)	($916,387)	($161,314)
6	$165,210	$159,450	$160,646	$308	($809,268)	($5,260)	($166,714)	($1,083,100)	($166,714)
7	$190,120	$165,210	$166,449	$294	($1,006,181)	($6,540)	($191,653)	($1,274,753)	($191,653)
8	$164,920	$190,120	$191,546	$231	($1,179,298)	($7,665)	($166,577)	($1,441,330)	($166,577)
9	$199,560	$164,920	$166,157	$294	($1,388,055)	($9,022)	($201,091)	($1,642,421)	($201,091)
10	$207,700	$199,560	$201,057	$208	($1,606,481)	($10,442)	($209,404)	($1,851,826)	($209,404)
11	$80,100	$207,700	$209,258	$187	($1,698,769)	($11,042)	($81,845)	($1,933,671)	($81,845)
12	$80,100	$80,100	$80,701	$506	($1,791,018)	($11,642)	($81,207)	($2,014,878)	($81,207)
13		$80,100	$80,701	$506	($1,803,766)	($11,724)	($1,107)	($2,015,985)	($1,107)
			$16,038	$3,133		$276		($18,895)	

NET INTEREST (In) = $18,895

DISTRIBUTION PROCESS :

PERIOD	CRp	Wo	Wo'	CRp'
1	$282,620	0.13	$2,497	$285,117
2	$238,980	0.11	$2,112	$241,092
3	$138,120	0.06	$1,220	$139,340
4	$231,520	0.11	$2,046	$233,566
5	$159,450	0.07	$1,409	$160,859
6	$165,210	0.08	$1,460	$166,670
7	$190,120	0.09	$1,680	$191,800
8	$164,920	0.08	$1,457	$166,377
9	$199,560	0.09	$1,763	$201,323
10	$207,700	0.10	$1,835	$209,535
11	$80,100	0.04	$708	$80,808
12	$80,100	0.04	$708	$80,808
		1.00	$18,895	$2,157,295

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF
1	$282.620	$141,310			$141,310	$919	($140,391)	($140,391)
2	$23P,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)
3	$138.120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)
9	$199,560	$166,377	$166,157	$294	($1,373,823)	($8,930)	($199,634)	($1,628,524)
10	$207,700	$201,323	$201,057	$208	($1,590,394)	($10,338)	($207,641)	($1,836,165)
11	$80,100	$209,535	$209,258	$187	($1,680,741)	($10,925)	($80,010)	($1,916,175)
12	$80,100	$80,808	$80,701	$506	($1,772,165)	($11,519)	($80,499)	($1,996,674)
13		$80,808	$80,701	$506	($1,784,084)	($11,597)	($399)	($1,997,074)

$16

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980				($96,751)	($629)	($239,609)	($380,000)	
3	$138,120	$526,209	$527,648	$0	($236,939)	($1,540)	($139,559)	($519,559)	($597)
4	$231,520	$139,340	$139,156	$361	($470,176)	($3,056)	($231,697)	($751,256)	
5	$159,450	$233,566	$233,256	$128	($632,501)	($4,111)	($159,268)	($910,524)	
6	$165,210	$160,859	$160,646	$308	($801,917)	($5,212)	($165,305)	($1,075,829)	
7	$190,120	$166,670	$166,449	$294	($997,322)	($6,483)	($190,193)	($1,266,022)	
8	$164,920	$191,800	$191,546	$231	($1,168,702)	($7,597)	($164,897)	($1,430,919)	
9	$199,560	$166,377	$166,157	$294	($1,375,932)	($8,944)	($199,634)	($1,630,553)	
10	$207,700	$201,323	$201,057	$208	($1,592,517)	($10,351)	($207,641)	($1,838,194)	
11	$80,100	$209,535	$209,258	$187	($1,682,878)	($10,939)	($80,010)	($1,918,204)	
12	$80,100	$80,808	$80,701	$506	($1,774,316)	($11,533)	($80,499)	($1,998,703)	
13		$80,808	$80,701	$506	($1,786,248)	($11,611)	($399)	($1,999,103)	

($2,013)

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120				($235,120)	($1,528)	($138,120)	($517,740)	
4	$231,520	$380,432	$381,734	$0	($469,471)	($3,052)	($232,822)	($750,562)	($127)
5	$159,450	$233,566	$233,256	$128	($631,791)	($4,107)	($159,268)	($909,831)	
6	$165,210	$160,859	$160,646	$308	($801,202)	($5,208)	($165,305)	($1,075,136)	
7	$190,120	$166,670	$166,449	$294	($996,603)	($6,478)	($190,193)	($1,265,329)	
8	$164,920	$191,800	$191,546	$231	($1,167,978)	($7,592)	($164,897)	($1,430,226)	
9	$199,560	$166,377	$166,157	$294	($1,375,204)	($8,939)	($199,634)	($1,629,860)	
10	$207,700	$201,323	$201,057	$208	($1,591,784)	($10,347)	($207,641)	($1,837,501)	
11	$80,100	$209,535	$209,258	$187	($1,682,140)	($10,934)	($80,010)	($1,917,511)	
12	$80,100	$80,808	$80,701	$506	($1,773,573)	($11,528)	($80,499)	($1,998,010)	
13		$80,808	$80,701	$506	($1,785,501)	($11,606)	($399)	($1,998,409)	
								($1,319)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520				($467,957)	($3,042)	($231,520)	($749,050)	
5	$159,450	$372,906	$373,456	$144	($631,142)	($4,102)	($160,144)	($909,194)	$144
6	$165,210	$160,859	$160,646	$308	($800,550)	($5,204)	($165,305)	($1,074,499)	
7	$190,120	$166,670	$166,449	$294	($995,946)	($6,474)	($190,193)	($1,264,691)	
8	$164,920	$191,800	$191,546	$231	($1,167,317)	($7,588)	($164,897)	($1,429,589)	
9	$199,560	$166,377	$166,157	$294	($1,374,539)	($8,935)	($199,634)	($1,629,223)	
10	$207,700	$201,323	$201,057	$208	($1,591,114)	($10,342)	($207,641)	($1,836,864)	
11	$80,100	$209,535	$209,258	$187	($1,681,466)	($10,930)	($80,010)	($1,916,874)	
12	$80,100	$80,808	$80,701	$506	($1,772,895)	($11,524)	($80,499)	($1,997,373)	
13		$80,808	$80,701	$506	($1,784,818)	($11,601)	($399)	($1,997,772)	
								($682)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450				($630,627)	($4,099)	($159,450)	($908,677)	
6	$165,210	$394,425	$395,652	$0	($801,163)	($5,208)	($166,437)	($1,075,114)	($143)
7	$190,120	$166,670	$166,449	$294	($996,563)	($6,478)	($190,193)	($1,265,307)	
8	$164,920	$191,800	$191,546	$231	($1,167,938)	($7,592)	($164,897)	($1,430,204)	
9	$199,560	$166,377	$166,157	$294	($1,375,164)	($8,939)	($199,634)	($1,629,838)	
10	$207,700	$201,323	$201,057	$208	($1,591,743)	($10,346)	($207,641)	($1,837,479)	
11	$80,100	$209,535	$209,258	$187	($1,682,100)	($10,934)	($80,010)	($1,917,489)	
12	$80,100	$80,808	$80,701	$506	($1,773,532)	($11,528)	($80,499)	($1,997,988)	
13		$80,808	$80,701	$506	($1,785,460)	($11,605)	($399)	($1,998,388)	
								($1,298)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210				($799,753)	($5,198)	($165,210)	($1,073,705)	
7	$190,120	$327,529	$328,300	$203	($996,045)	($6,474)	($191,094)	($1,264,799)	$203
8	$164,920	$191,800	$191,546	$231	($1,167,417)	($7,588)	($164,897)	($1,429,697)	
9	$199,560	$166,377	$166,157		($1,374,639)	($8,935)	($199,634)	($1,629,331)	
10	$207,700	$201,323	$201,057	$2[illegible]	($1,591,215)	($10,343)	($207,641)	($1,836,972)	
11	$80,100	$209,535	$209,258	$187	($1,681,568)	($10,930)	($80,010)	($1,916,981)	
12	$80,100	$80,808	$80,701	$506	($1,772,998)	($11,524)	($80,499)	($1,997,481)	
13		$80,808	$80,701	$506	($1,784,921)	($11,602)	($399)	($1,997,880)	
								($790)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120				($995,167)	($6,469)	($190,120)	($1,263,920)	
8	$164,920	$358,470	$359,243	$112	($1,167,441)	($7,588)	($165,805)	($1,429,726)	$112
9	$199,560	$166,377	$166,157	$294	($1,374,663)	($8,935)	($199,634)	($1,629,360)	
10	$207,700	$201,323	$201,057	$208	($1,591,240)	($10,343)	($207,641)	($1,837,001)	
11	$80,100	$209,535	$209,258	$187	($1,681,593)	($10,930)	($80,010)	($1,917,011)	
12	$80,100	$80,808	$80,701	$506	($1,773,022)	($11,525)	($80,499)	($1,997,510)	
13		$80,808	$80,701	$506	($1,784,946)	($11,602)	($399)	($1,997,909)	
								($819)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920				($1,166,629)	($7,583)	($164,920)	($1,428,913)	
9	$199,560	$358,177	$359,139	$50	($1,374,784)	($8,936)	($200,572)	($1,629,486)	$50
10	$207,700	$201,323	$201,057	$208	($1,591,362)	($10,344)	($207,641)	($1,837,127)	
11	$80,100	$209,535	$209,258	$187	($1,681,715)	($10,931)	($80,010)	($1,917,136)	
12	$80,100	$80,808	$80,701	$506	($1,773,146)	($11,525)	($80,499)	($1,997,636)	
13		$80,808	$80,701	$506	($1,785,070)	($11,603)	($399)	($1,998,035)	
								($945)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($135,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560				($1,373,749)	($8,929)	($199,560)	($1,628,450)	
10	$207,700	$367,701	$368,460	$90	($1,591,227)	($10,343)	($208,549)	($1,836,999)	$90
11	$80,100	$209,535	$209,258	$187	($1,681,580)	($10,930)	($80,010)	($1,917,009)	
12	$80,100	$80,808	$80,701	$506	($1,773,010)	($11,525)	($80,499)	($1,997,508)	
13		$80,808	$80,701	$506	($1,784,934)	($11,602)	($399)	($1,997,908)	
									($818)

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560	$166,377	$166,157	$294	($1,373,823)	($8,930)	($199,634)	($1,628,524)	
10	$207,700				($1,590,453)	($10,338)	($207,700)	($1,836,224)	
11	$80,100	$410,859	$411,822	$0	($1,681,855)	($10,932)	($81,064)	($1,917,288)	($104)
12	$80,100	$80,808	$80,701	$506	($1,773,286)	($11,526)	($80,499)	($1,997,787)	
13		$80,808	$80,701	$506	($1,785,212)	($11,604)	($399)	($1,998,187)	
									($1,097)

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560	$166,377	$166,157	$294	($1,373,823)	($8,930)	($199,634)	($1,628,524)	
10	$207,700	$201,323	$201,057	$208	($1,590,394)	($10,338)	($207,641)	($1,836,165)	
11	$80,100				($1,680,831)	($10,925)	($80,100)	($1,916,265)	
12	$80,100	$290,343	$291,528	$174	($1,773,216)	($11,526)	($81,459)	($1,997,725)	$174
13		$80,808	$80,701	$506	($1,785,141)	($11,603)	($399)	($1,998,124)	
								($1,034)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560	$166,377	$166,157	$294	($1,373,823)	($8,930)	($199,634)	($1,628,524)	
10	$207,700	$201,323	$201,057	$208	($1,590,394)	($10,338)	($207,641)	($1,836,165)	
11	$80,100	$209,535	$209,258	$187	($1,680,741)	($10,925)	($80,010)	($1,916,175)	
12	$80,100				($1,771,766)	($11,516)	($80,100)	($1,996,275)	
13		$161,616	$162,007	$812	($1,784,486)	($11,599)	($1,204)	($1,997,479)	$812
								($389)	

IDENTIFICATION OF DISRUPTION CONSEQUENCE :

2	($2,013)
3	($1,319)
4	($682)
5	($1,298)
6	($790)
7	($819)
8	($945)
9	($818)
10	($1,097)
11	($1,034)
12	($389)

MCF = ($2,013)

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980				($96,751)	($629)	($239,609)	($380,000)	
3	$138,120				($235,500)	($1,531)	($138,120)	($518,120)	
4	$231,520	$665,549	$670,773	$0	($473,775)	($3,080)	($236,744)	($754,864)	($1,540)
5	$159,450	$233,566	$233,256	$128	($636,123)	($4,135)	($159,268)	($914,133)	
6	$165,210	$160,859	$160,646	$308	($805,563)	($5,236)	($165,305)	($1,079,438)	
7	$190,120	$166,670	$166,449	$294	($1,000,992)	($6,506)	($190,193)	($1,269,631)	
8	$164,920	$191,800	$191,546	$231	($1,172,396)	($7,621)	($164,897)	($1,434,528)	
9	$199,560	$166,377	$166,157	$294	($1,379,650)	($8,968)	($199,634)	($1,634,162)	
10	$207,700	$201,323	$201,057	$208	($1,596,259)	($10,376)	($207,641)	($1,841,803)	
11	$80,100	$209,535	$209,258	$187	($1,686,644)	($10,963)	($80,010)	($1,921,813)	
12	$80,100	$80,808	$80,701	$506	($1,778,107)	($11,558)	($80,499)	($2,002,312)	
13		$80,808	$80,701	$506	($1,790,064)	($11,635)	($399)	($2,002,711)	
								($5,621)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120				($235,120)	($1,528)	($138,120)	($517,740)	
4	$231,520				($468,169)	($3,043)	($231,520)	($749,260)	
5	$159,450	$613,998	$617,864	$0	($634,528)	($4,124)	($163,316)	($912,577)	($942)
6	$165,210	$160,859	$160,646	$308	($803,957)	($5,226)	($165,305)	($1,077,882)	
7	$190,120	$166,670	$166,449	$294	($999,376)	($6,496)	($190,193)	($1,268,074)	
8	$164,920	$191,800	$191,546	$231	($1,170,769)	($7,610)	($164,897)	($1,432,972)	
9	$199,560	$166,377	$166,157	$294	($1,378,013)	($8,957)	($199,634)	($1,632,606)	
10	$207,700	$201,323	$201,057	$208	($1,594,61[illegible])	($10,365)	($207,641)	($1,840,247)	
11	$80,100	$209,535	$209,258	$187	($1,684,986)	($10,952)	($80,010)	($1,920,256)	
12	$80,100	$80,808	$80,701	$506	($1,776,438)	($11,547)	($80,499)	($2,000,756)	
13		$80,808	$80,701	$506	($1,788,384)	($11,624)	($399)	($2,001,155)	
								($4,065)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520				($467,957)	($3,042)	($231,520)	($749,050)	
5	$159,450				($630,449)	($4,098)	($159,450)	($908,500)	
6	$165,210	$533,765	$536,909	$0	($802,901)	($5,219)	($168,354)	($1,076,854)	($472)
7	$190,120	$166,670	$166,449	$294	($998,312)	($6,489)	($190,193)	($1,267,047)	
8	$164,920	$191,800	$191,546	$231	($1,169,699)	($7,603)	($164,897)	($1,431,944)	
9	$199,560	$166,377	$166,157	$294	($1,376,936)	($8,950)	($199,634)	($1,631,578)	
10	$207,700	$201,323	$201,057	$208	($1,593,527)	($10,358)	($207,641)	($1,839,219)	
11	$80,100	$209,535	$209,258	$187	($1,683,894)	($10,945)	($80,010)	($1,919,229)	
12	$80,100	$80,808	$80,701	$506	($1,775,339)	($11,540)	($80,499)	($1,999,728)	
13		$80,808	$80,701	$506	($1,787,278)	($11,617)	($399)	($2,000,128)	
								($3,038)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450				($630,627)	($4,099)	($159,450)	($908,677)	
6	$165,210				($799,936)	($5,200)	($165,210)	($1,073,887)	
7	$190,120	$561,094	$565,078	$0	($999,239)	($6,495)	($194,104)	($1,267,991)	($827)
8	$164,920	$191,800	$191,546	$231	($1,170,632)	($7,609)	($164,897)	($1,432,888)	
9	$199,560	$166,377	$166,157	$294	($1,377,875)	($8,956)	($199,634)	($1,632,522)	
10	$207,700	$201,323	$201,057	$208	($1,594,472)	($10,364)	($207,641)	($1,840,163)	
11	$80,100	$209,535	$209,258	$187	($1,684,846)	($10,951)	($80,010)	($1,920,173)	
12	$80,100	$80,808	$80,701	$506	($1,776,297)	($11,546)	($80,499)	($2,000,672)	
13		$80,808	$80,701	$506	($1,788,242)	($11,624)	($399)	($2,001,072)	
								($3,982)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210				($799,753)	($5,198)	($165,210)	($1,073,705)	
7	$190,120				($995,071)	($6,468)	($190,120)	($1,263,825)	
8	$164,920	$519,329	$522,315	$0	($1,169,446)	($7,601)	($167,906)	($1,431,732)	($378)
9	$199,560	$166,377	$166,157	$294	($1,376,681)	($8,948)	($199,634)	($1,631,366)	
10	$207,700	$201,323	$201,057	$208	($1,593,271)	($10,356)	($207,641)	($1,839,007)	
11	$80,100	$209,535	$209,258	$187	($1,683,637)	($10,944)	($80,010)	($1,919,017)	
12	$80,100	$80,808	$80,701	$506	($1,775,080)	($11,538)	($80,499)	($1,999,516)	
13		$80,808	$80,701	$506	($1,787,017)	($11,616)	($399)	($1,999,915)	
								($2,825)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120				($995,167)	($6,469)	($190,120)	($1,263,920)	
8	$164,920				($1,166,556)	($7,583)	($164,920)	($1,428,840)	
9	$199,560	$524,847	$528,102	$0	($1,376,953)	($8,950)	($202,815)	($1,631,655)	($482)
10	$207,700	$201,323	$201,057	$208	($1,593,544)	($10,358)	($207,641)	($1,839,296)	
11	$80,100	$209,535	$209,258	$187	($1,683,912)	($10,945)	($80,010)	($1,919,306)	
12	$80,100	$80,808	$80,701	$506	($1,775,357)	($11,540)	($80,499)	($1,999,805)	
13		$80,808	$80,701	$506	($1,787,296)	($11,617)	($399)	($2,000,205)	
								($3,115)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920				($1,166,629)	($7,583)	($164,920)	($1,428,913)	
9	$199,560				($1,373,772)	($8,930)	($199,560)	($1,628,473)	
10	$207,700	$559,500	$562,898	$0	($1,593,799)	($10,360)	($211,098)	($,839,571)	($630)
11	$80,100	$209,535	$209,258	$187	($1,684,169)	($10,947)	($80,010)	($1,919,581)	
12	$80,100	$80,808	$80,701	$506	($1,775,615)	($11,541)	($80,499)	($2,000,080)	
13		$80,808	$80,701	$506	($1,787,556)	($11,619)	($399)	($2,000,479)	
								($3,389)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560				($1,373,749)	($8,929)	($199,560)	($1,628,450)	
10	$207,700				($1,590,378)	($10,337)	($207,700)	($1,836,150)	
11	$80,100	$577,236	$580,488	$0	($1,684,068)	($10,946)	($83,353)	($1,919,503)	($634)
12	$80,100	$80,808	$80,701	$506	($1,775,514)	($11,541)	($80,499)	($2,000,002)	
13		$80,808	$80,701	$506	($1,787,454)	($11,618)	($399)	($2,000,401)	
								($3,311)	

SAMPLE CASE STUDY

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560	$166,377	$166,157	$294	($1,373,823)	($8,930)	($199,634)	($1,628,524)	
10	$207,700				($1,590,453)	($10,338)	($207,700)	($1,836,224)	
11	$80,100				($1,680,891)	($10,926)	($80,100)	($1,916,324)	
12	$80,100	$491,666	$495,621	$0	($1,775,871)	($11,543)	($84,054)	($2,000,379)	($616)
13		$80,808	$80,701	$506	($1,787,813)	($11,621)	($399)	($2,000,778)	
								($3,688)	

PERIOD	CRp	Pi	LRp	F	SELF.BAL	Ids	NCF	CCF	
1	$282,620	$141,310			$141,310	$919	($140,391)	($140,391)	
2	$238,980	$285,117	$284,740	$0	($96,374)	($626)	($239,229)	($379,620)	
3	$138,120	$241,092	$240,772	$109	($234,910)	($1,527)	($137,910)	($517,530)	
4	$231,520	$139,340	$139,156	$361	($468,134)	($3,043)	($231,697)	($749,227)	
5	$159,450	$233,566	$233,256	$128	($630,445)	($4,098)	($159,268)	($908,495)	
6	$165,210	$160,859	$160,646	$308	($799,848)	($5,199)	($165,305)	($1,073,800)	
7	$190,120	$166,670	$166,449	$294	($995,240)	($6,469)	($190,193)	($1,263,993)	
8	$164,920	$191,800	$191,546	$231	($1,166,606)	($7,583)	($164,897)	($1,428,890)	
9	$199,560	$166,377	$166,157	$294	($1,373,823)	($8,930)	($199,634)	($1,628,524)	
10	$207,700	$201,323	$201,057	$208	($1,590,394)	($10,338)	($207,641)	($1,836,165)	
11	$80,100				($1,680,831)	($10,925)	($80,100)	($1,916,265)	
12	$80,100				($1,771,857)	($11,517)	($80,100)	($1,996,365)	
13		$371,151	$374,424	$0	($1,786,647)	($11,613)	($3,274)	($1,999,639)	($39)
								($2,549)	

IDENTIFICATION OF DISRUPTION CONSEQUENCE :

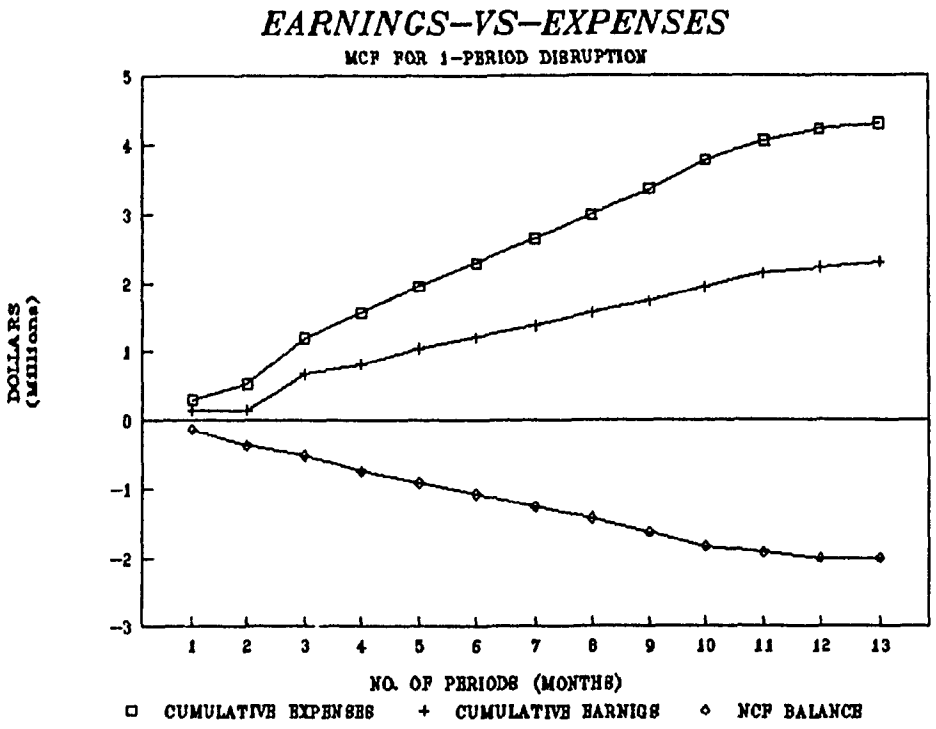
2-3	($5,621)
3-4	($4,065)
4-5	($3,038)
5-6	($3,982)
6-7	($2,825)
7-8	($3,115)
8-9	($3,389)
9-10	($3,311)
10-11	($3,688)
11-12	($2,549)

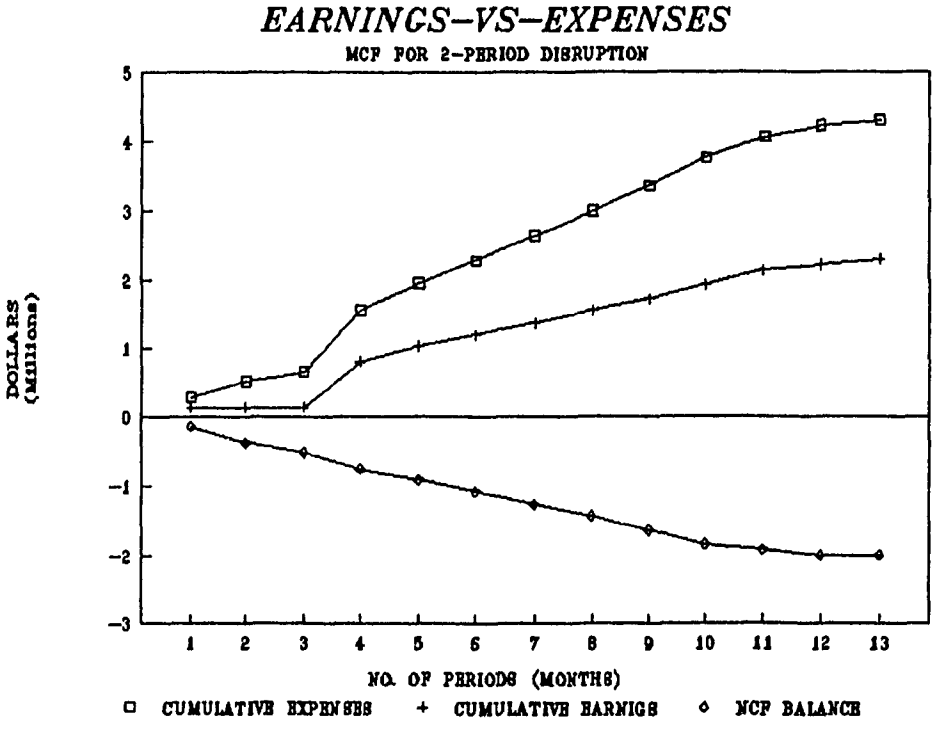
MCF = ($5,621)

SAMPLE CASE STUDY

ADDED FINANCING COSTS (Cf):

1 - PERIOD DISRUPTION =	($2,013)	0.094%
2 - PERIOD DISRUPTION =	($5,621)	0.263%


EARNINGS–VS–EXPENSES
MCF FOR 1-PERIOD DISRUPTION
DOLLARS (Millions)
5
4
3
2
1
0
-1
-2
-3
1 2 3 4 5 6 7 8 9 10 11 12 13
NO. OF PERIODS (MONTHS)
□ CUMULATIVE EXPENSES + CUMULATIVE EARNIGS ◇ NCF BALANCE


EARNINGS–VS–EXPENSES
MCF FOR 2-PERIOD DISRUPTION
DOLLARS (Millions)
5
4
3
2
1
0
-1
-2
-3
1 2 3 4 5 6 7 8 9 10 11 12 13
NO. OF PERIODS (MONTHS)
□ CUMULATIVE EXPENSES + CUMULATIVE EARNIGS ◇ NCF BALANCE

A-6 QUANTIFICATION OF REDUCTION IN PROGRESS RATES

The contractor inputs the original durations for the critical activities within each period. The payment disruptions are performed for 1 and 2 consecutive payment periods for the established project work schedule.

REDUCTION IN PROGRESS RATE

MONTH	Po	y	Pd	IR	Pr	Ao	Ae	Ared
JAN	360	26	386	107.2	7.2%	26	24	2
							0	0
							0	0
FEB	334	29	363	108.7	8.7%	29	26	3
							0	0
							0	0
MAR	305	31	336	110.2	10.2%	5	4	1
							0	0
							0	0
APR	275	30	305	110.9	10.9%	26	23	3
							0	0
							0	0
MAY	244	31	275	112.7	12.7%	31	27	4
							0	0
							0	0
JUN	213	30	243	114.1	14.1%	30	26	4
							0	0
							0	0
JUL	183	31	214	116.9	16.9%	3	2	1
						28	23	5
							0	0
AUG	152	31	183	120.4	20.4%	31	25	6
							0	0
							0	0
SEP	121	30	151	124.8	24.8%	1	1	0
						29	22	7
							0	0
OCT	91	31	122	134.1	34.1%	31	20	11
							0	0
							0	0
NOV	60	30	90	150.0	50.0%	30	15	15
							0	0
							0	0
DEC	30	30	60	200.0	100.0%	30	0	30
							0	0
							0	0

MAX Ared ==> 30

SAMPLE CASE STUDY

Ao' =	30
AO* =	60
MAred =	30
DRP =	30
Epr =	100%
Cro =	$80,100
Cre =	$160,200
C<MAred =	$2,058,300
Cet =	$2,218,500
Cot =	$2,138,400
N =	12
Cp =	0.313%

SAMPLE CASE STUDY

MONTH	Po	y	Pd	IR	Pr	Ao	Ae	Ared
JAN	360	55	415	115.3	15.3%	26	22	4
							0	0
							0	0
FEB	334	60	394	118.0	18.0%	29	24	5
							0	0
							0	0
MAR	305	61	366	120.0	20.0%	5	4	1
							0	0
							0	0
APR	275	61	336	122.2	22.2%	26	20	6
							0	0
							0	0
MAY	244	61	305	125.0	25.0%	31	23	8
							0	0
							0	0
JUN	213	61	274	128.6	28.6%	30	21	9
							0	0
							0	0
JUL	183	62	245	133.9	33.9%	3	2	1
						28	19	9
							0	0
AUG	152	61	213	140.1	40.1%	31	19	12
							0	0
							0	0
SEP	121	61	182	150.4	50.4%	1	0	1
						29	14	15
							0	0
OCT	91	61	152	167.0	67.0%	31	10	21
							0	0
							0	0
NOV	60	61	121	201.7	101.7%	30	0	31
							0	0
							0	0
DEC	30	30	60	200.0	100.0%	30	0	30
							0	0
							0	0

MAX Ared ==> 31

SAMPLE CASE STUDY

Ao' =	30
AO* =	60
MAred =	31
DRP =	60
Epr =	51%
Cro =	$160,200
Cre =	$241,635
C<MAred =	$1,978,200
Cet =	$2,219,835
Cot =	$2,138,400
N =	12
Cp =	0.318%