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Case Study Approach Using Scenario Analysis to Analyze Unabsorbed Head Office Overheads

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***Abstract*—**Head office overhead (HOOH) is an indirect cost and is recovered through individual project billings by the contractor. Delay in a project impacts the absorption of HOOH cost allocated to that particular project and thus diminishes the expected profit of the contractor. This unabsorbed HOOH cost is later claimed by contractors as damages. The subjective nature of the available formulae to compute unabsorbed HOOH is the difficulty that contractors and owners face and thus dispute it. The paper attempts to bring together the rationale of various HOOH formulae by gathering contractor's HOOH cost data on all of its project, using case study approach and comparing variations in values of HOOH using scenario analysis. The case study approach uses project data collected from four construction projects of a contractor in India to calculate unabsorbed HOOH costs from various available formulae. Scenario analysis provides further variations in HOOH values after considering two independent situations mainly scope changes and new projects during the delay period. Interestingly, one of the findings in this study reveals that, in spite of HOOH getting absorbed by additional works available during the period of delay, a few formulae depict an increase in the value of unabsorbed HOOH, neglecting any absorption by the increase in scope. This indicates that these formulae are inappropriate for use in case of a change to the scope of work. Results of this study can help both parties in deciding on an appropriate formula more objectively, considering the events on a project causing the delay and contractor's position in respect of obtaining new projects.

***Keywords*—**Absorbed and unabsorbed overheads, head office overheads, scenario analysis, scope variation

I. Introduction

HOOH is the cost of running contractor's permanent office to support a group of projects [1]. This usually consists of the expenses like head office staff salaries, office electricity, rent of office space, office equipment, employee recruitment, training and development, photocopying, postage, advertising, insurance premiums, and so on [2]. These costs are not assigned in any particular manner across several projects. Instead, a heuristic approach is adopted to book the costs amongst them as decided by the management of a contractor. While bidding for a project, a contractor assumes a certain percentage of the direct cost estimate as the HOOH cost based on his/her experience and the number of projects in hand. This cost is then added to the Bill of Quantities (BOQ) items as a part of markup to arrive at the final bid price. From the amount received against each running bill of the project, contractor recovers HOOH cost along with the expenditure and profit. Whenever there is a delay in the project, the actual invoice raised for the work done during this period is less than the budgeted value, thereby less realisation of HOOH amount for that period. As a result, part of HOOH cost of the project remains unabsorbed/unrecovered, which then becomes an unforeseen burden onto the contractor leading to claims. Such claims are hard to compute and reconcile because they are accrued as expense centrally to all projects, but they need to be absorbed from individual projects. Contract claims for HOOH damages are among the most litigated of all delay claims. There are many formulae available in the literature to estimate HOOH during the delay period, and they are also practiced in the industry. But, these formulae result only in a reasonable approximation.

A project can get delayed due to various reasons like suspension of work by owner, the increment in the scope of work, incapability of contractor of finishing the project in time, pending decisions and capital shortage. A contractor is entitled to get compensation only for the owner-caused delays (OCD), and therefore, the OCD days must decide on the HOOH cost compensation. However, the contractor is also required to prove that there was uncertainty in the period of suspension causing the delay and was incapable of getting new projects during the period of delay. The logic behind this notion is that if a contractor is able to find replaceable work (either due to increase in scope of work or getting new projects during period of delay) and uses HOOH resources for this additional work, the revenue from this additional work covers the amount expected from original project to pay for its unabsorbed HOOH. In such cases, contractor's claim for HOOH for the period of delay is generally denied [3]. Out of the various causes of delay, variations or scope changes have been observed to be the most common causes of delays [4], [5], and therefore it is required to assess the HOOH values using the various formulas for scope variation during the period of delay.

II. Literature Review

To avoid underestimating of the HOOH costs while bidding, researchers have worked on various approaches to determine the lower limit of HOOH [6]-[8]. The model proposed by Farid and Boyer provides a fair and reasonable markup mode to avoid under-estimation of the HOOH while bidding [9]. These models are relevant to contractors for

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assessing prior to bidding and assist their management in decision making and are usually known to owners unless it is a cost-plus contract. Ibbs et al. have provided a process model for recovery of HOOH cost using the Eichleay formula [3]. Thereafter, the guidelines for HOOH recovery through Eichleay formula were listed out by Davis and Ibbs, after reviewing the court cases [10]. The formulas are a creation of the courts, and therefore, the research papers focus entirely on the court decisions to define the bounds of its application. There are many formulae like Eichleay formula, modified Eichleay formula, burden fluctuation method, Canadian method, Allegheny formula, Emden formula, Carteret formula, Hudson formula, Ernstrom formula, total direct cost allocation (TDCA) method and comparative absorption rate (CAR) method available in the literature to calculate HOOH for delayed construction project. In the past, researchers have tried to understand the background of various formulae available in the industry to calculate HOOH for a delayed construction project and explain their evolution, theoretical assumptions, and limitations [11], [12]. To explain the usage of these formulae, mostly hypothetical data have been used. All these methods have been questioned and criticized for various situations in various cases indicating that no method is superior to other. Few works tried to give a new formula for estimating HOOH [13], [2]. But, no attempt has been made so far to clarify which formula is capable of taking into account even the partial/whole absorption of HOOH costs when the contractor is able to find replaceable work during the period of delay with the same owner or others.

Scenario analysis has been extensively used since 1964 for analyzing the future events at the global level. The analysis provides a flexible strategy approach to forecast and has been used extensively in the business environment. A scenario 'is a hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points [14], and it can be used to provide both foresight and insight [15]. In this paper, it is the latter. The model preparation involves studying and understanding the cause and effect and observing trends [15], and for this purpose, case study approach was used to gather data from construction projects and contractor's books of account. Case study approach is a quintessential technique when the idea is to study the natural settings of a system [16]. The approach helps to relate to the events of the projects, and that is the intention in exploring the factors alluding to the absorption of HOOH cost as defined in the various HOOH formulae. The formulae computing the unabsorbed HOOH has been checked under two situations, i.e. increase in the scope of work and contractor getting new projects during the delay period of a project, by considering various scenarios. In this study, authors have compared the various formulae being used in the industry through the data collected from construction projects of a contractor for a given period of time. Through this analysis, the study explores the applicability of different formulae when additional or replaceable work is available during the period of delay. The study concludes on the set of formulae that are sensitive to the HOOH getting absorbed due to the availability of replaceable/additional work while calculating HOOH for the delayed period. The intended audience is the owner, contractor or any other stakeholder of the project who may be affected by the unabsorbed HOOH cost for a delayed construction project.

III. Methodology

Through literature study, various parameters affecting HOOH calculations were identified, and they form the fundamental system drivers for the scenario analysis. The data for the identified parameters were collected from four construction projects of the same contractor. Various scenarios were considered thereafter, in which additional work was given to the contractor during the same period of delay of each project. Further scenarios were considered where replaceable work was available to the contractor from other projects during the same period of delay. HOOH values were calculated for each of the scenarios and based on the comparison of the trends followed by each formula for various scenarios of scope, variation conclusions are made. HOOH values were calculated for all of these projects using all the available formulae in the literature to observe the expected trends. The model for scenario analysis in this paper considers the internal causes of change for HOOH and not the external factors since for the duration of a project span this assessment does not yield any change in them. For forecasts along longer time spans, the external factors can be said to be essential.

TABLE I
Primary Data (Project 1)

Identified Parameters	Unit	Value
Contractor's revenue during originally planned project duration	INR	3,575,000,000
Contractor's revenue during actual completion period of project	INR	7,540,000,000
Labour cost to contractor during actual completion period of project	INR	2,714,400,000
Original contract value of the project	INR	795,400,000
Revised contract value of project on completion	INR	598,800,000
Project billing amount during the original period	INR	416,325,220
Project billing amount during the actual period	INR	583,188,709
Billing is done during the delay period	INR	166,863,489
Labour costs to project during the actual completion period	INR	215,568,000
Labour costs to project during the delay period	INR	65,690,920.80
Contractor's overhead during the original period of the project	INR	185,300,000
Contractor's overhead during the actual period of the project	INR	403,300,000
Planned contract duration of the project	Days	514
The actual duration of the project	Days	1125
Extended duration of the project	Days	611
Owner caused delay	Days	481
Planned overhead & profit % during the bid	%	14.75%
Original HOOH %	%	5.183%

A. Project 1

The first study undertaken was a bridge construction project, experiencing delay caused by both owner and contractor caused events. The contract value of the project was INR 795.4 million which was revised to INR 598.8 million during the execution phase of the project, i.e. the original case study experienced a reduction in scope of work. The contract duration of the project was 17 months. The project was completed in 37 months (delay of approximately 118%). A large pool of primary data was collected from the project, and then the parameters affecting HOOH claim in various formulae were identified as shown in Table I. Based on the data collected, HOOH value for the delay period has been calculated using the formulae given in the literature [11], [12]. HOOH values obtained using different formulae are summarised in Table II and presented in Fig. 1.

From Fig. 1, it can be seen easily that for the same set of data the value of HOOH given by different formulae varies greatly. This reflects that selection of formula to calculate HOOH can significantly affect the value of the claim for HOOH for the delayed period. It can also be seen that values given by Direct and Canadian method are equal.

1) Analysis by Varying Scope of Work

Two variables have been chosen to analyse the data collected and the same has been analysed over different scenarios to understand the applicability and sensitivity of various formulae towards the availability of replaceable work during the period of delay. The first variable taken is the change in scope of work. Seven scenarios have been considered in the first study where the scope of work has been changed. In the first scenario, a decrement in scope of the work has been considered (which was the actual case), followed by no change in scope of work in the second scenario. Then, scope increment by 25% has been considered in the next four scenarios, i.e. total scope increment of 25%, 50%, 75% and 100% in scenarios 3, 4, 5 and 6, respectively. The last scenario is the increment in the scope of work which justifies the fixed period of delay, i.e. an increment of scope by 118%. Throughout these seven scenarios, the value of input parameters like actual monthly HOOH expense, OCD days, original contract value and original contract period has been kept constant. Amount of billing during original and delayed period has been varied in the same proportion as it was in the original case of the project. Contractor's revenue for the actual period is varying with a change in scope of work. Data for the scenarios are represented in Table III. Value for HOOH is calculated for each scenario of Project1 using all formulae as summarised in Table IV, and trends for each formula are presented in Fig. 2.

From Fig. 2, it can be seen that the HOOH calculation formulae can be broadly categorized into three groups based on the trends that they depict with each scenario. The first group includes Eichleay, modified Eichleay, Ernstrom and total direct cost allocation formulae. These depict an increase in the value of unabsorbed HOOH with each scenario, even though it is expected that some component of HOOH is actually getting absorbed due to increase in the scope of work within the same period of delay.

TABLE II
SUMMARY OF HOOH VALUES FOR PROJECT 1 USING VARIOUS FORMULAE

Formula used	Values in INR
Eichleay formula	13,337,012
Modified Eichleay formula	13,412,049
Burden fluctuation method	11,519,755
Canadian method	38,580,417
Allegheny method	1,317,100
Comparative absorption rate method	12,485,455
Carteret Formula	525,439
Direct Method	38,580,417
Total Direct Cost Allocation method	25,985,715
Hudson Formula	109,789,186
Ernstrom Formula	9,760,223
Emden Formula	109,789,186

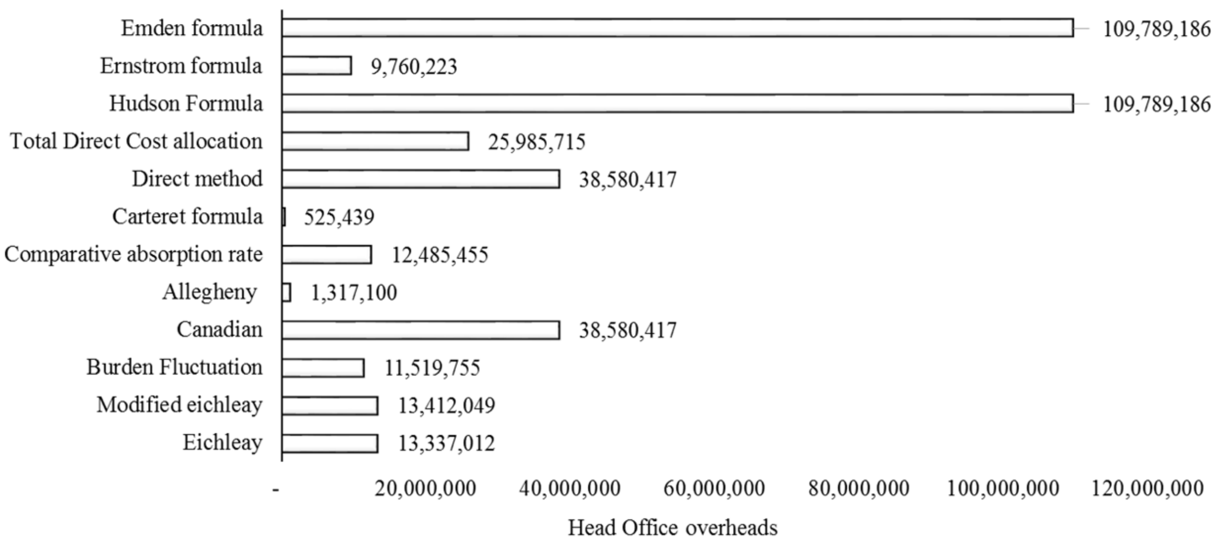

Fig. 1 Bar chart representing HOOH values of Project 1 using different formulae

TABLE III
SCENARIO ANALYSIS BY VARYING SCOPE OF WORK (PROJECT1)

Input Parameters	Scenario1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
Total contractor's revenue for original period, ’000 INR	3,575,000	3,575,000	3,575,000	3,575,000	3,575,000	3,575,000	3,575,000
Total contractor's revenue: Actual Period ’000 INR	5,290,000	5,500,000	5,700,000	5,900,000	6,100,000	6,300,000	6,450,972
Total labour cost during Actual Period ’000 INR	1,904,400	1,980,000	2,052,000	2,124,000	2,196,000	2,268,000	2,322,350
Original contract value ’000 INR	795,400	795,400	795,400	795,400	795,400	795,400	795,400
Total contract value (before claim) ’000 INR	598,800	795,400	994,250	1,193,100	1,391,950	1,590,800	1,740,904
Project billings during original period ’000 INR	416,325	553,014	691,268	829,521	967,775	1,106,028	1,210,391
Project billings during actual period ’000 INR	583,188	795,400	994,250	1,193,100	1,391,950	1,590,800	1,740,904
Project billings during delay period ’000 INR	166,863	242,385	302,981	363,578	424,174	484,771	530,513
Project labour costs during actual period ’000 INR	215,568	286,344	357,930	429,516	501,102	572,688	626,725
Project labour costs during delay period ’000 INR	65,690	87,258	109,073	130,888	152,702	174,517	190,984
Contractor overhead during original period ’000 INR	185,300	185,300	185,300	185,300	185,300	185,300	185,300
Contractor overhead during actual period ’000 INR	403,300	403,300	403,300	403,300	403,300	403,300	403,300
Total overhead & profit actual period ’000 INR	780,275	811,250	840,750	870,250	899,750	929,250	951,518
Planned contract duration (days)	514	514	514	514	514	514	514
Actual duration (days)	1125	1125	1125	1125	1125	1125	1125
Extended duration (days)	611	611	611	611	611	611	611
OCD (days)	481	481	481	481	481	481	481
Original HOOH %	5.183%	5.183%	5.183%	5.183%	5.183%	5.183%	5.183%

TABLE IV
SUMMARY OF HOOH IN DIFFERENT SCENARIOS OF SCOPE VARIATION (PROJECT1)

Formula	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7
	Values	Values	Values	Values	Values	Values	Values
Eichleay	19,009,654	24,936,969	30,077,485	34,869,491	39,347,267	43,540,740	46,534,018
Modified Eichleay	19,116,607	25,077,271	30,246,708	35,065,676	39,568,645	43,785,711	46,795,830
BFM	114,874,518	101,125,870	89,043,228	77,775,707	67,243,130	57,375,504	50,329,599
Canadian	38,580,417	38,580,417	38,580,417	38,580,417	38,580,417	38,580,417	38,580,417
Allegheny	19,412,546	17,097,206	15,050,732	13,143,002	11,360,369	9,690,919	8,499,275
CAR	129,107,832	118,223,077	107,856,643	97,490,210	87,123,776	76,757,343	68,932,097
Carteret	12,561,740	14,886,005	15,378,169	15,245,299	14,635,919	13,654,948	12,715,480
Direct	38,580,417	38,580,417	38,580,417	38,580,417	38,580,417	38,580,417	38,580,417
TDCA	38,449,020	50,927,260	63,643,518	76,353,562	89,057,398	101,755,028	111,335,903
Hudson	109,789,186	109,789,186	109,789,186	109,789,186	109,789,186	109,789,186	109,789,186
Ernstrom	13,911,546	17,773,468	21,437,297	24,852,731	28,044,202	31,033,039	33,166,456
Emden	109,789,186	109,789,186	109,789,186	109,789,186	109,789,186	109,789,186	109,789,186

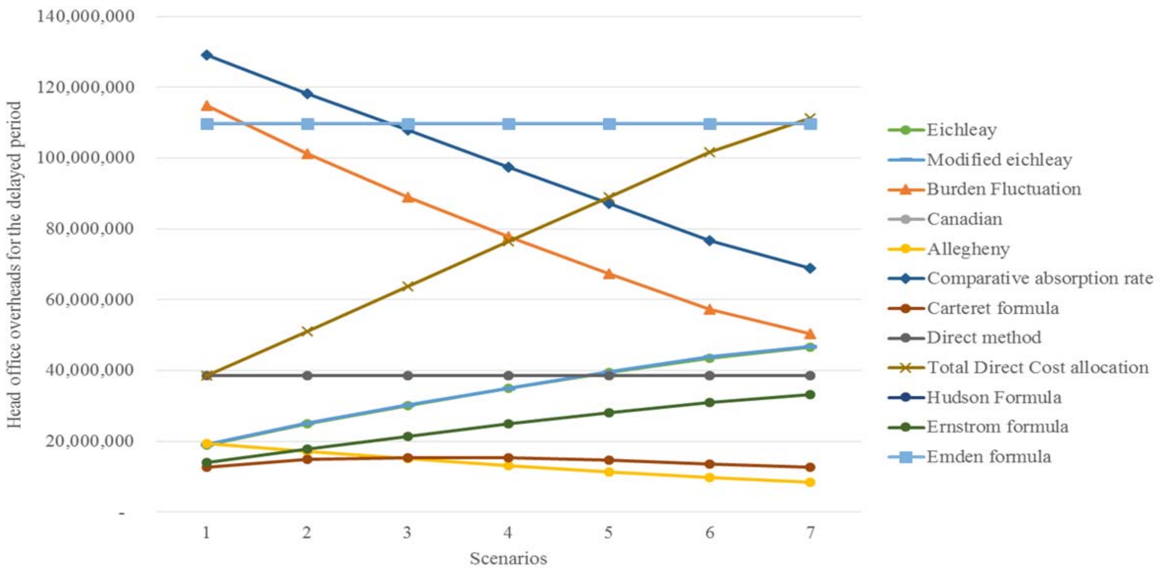

Fig. 2 HOOH trend lines for different scenarios of scope variation (Project 1)

TABLE V
SCENARIO ANALYSIS FOR NEW PROJECTS DURING THE PERIOD OF DELAY (PROJECT 1)

Input Parameters	Scenario 8	Scenario 9	Scenario 10
Total contractor's revenue: original period (INR)	3,575,000,000	3,575,000,000	3,575,000,000
Total contractor's revenue: actual period (INR)	5,290,000,000	6,812,500,000	7,750,000,000
Total labour cost: actual period (INR)	1,904,400,000	2,452,500,000	2,790,000,000
Original contract value (INR)	795,400,000	795,400,000	795,400,000
Total contract value (before claim) (INR)	598,800,000	795,400,000	795,400,000
Billings during original period (INR)	416,325,220	363,409,422	363,409,422
Billings during actual period (INR)	583,188,709	795,400,000	795,400,000
Billings during delay period (INR)	166,863,489	431,990,577	431,990,577
Project labour costs during actual period (INR)	215,568,000	286,344,000	286,344,000
Project labour costs during delay period (INR)	65,690,921	155,516,608	155,516,608
Contractor overhead during original period (INR)	185,300,000	185,300,000	185,300,000
Contractor overhead during actual period (INR)	403,300,000	403,300,000	403,300,000
Total overhead & profit actual period (INR)	780,275,000	1,004,843,750	1,143,125,000
Planned contract duration (days)	514	514	514
Actual duration (days)	1125	1125	1125
Extended duration (days)	611	611	611
OCD (days)	481	481	481
Original HOOH %	5.183%	5.183%	5.183%

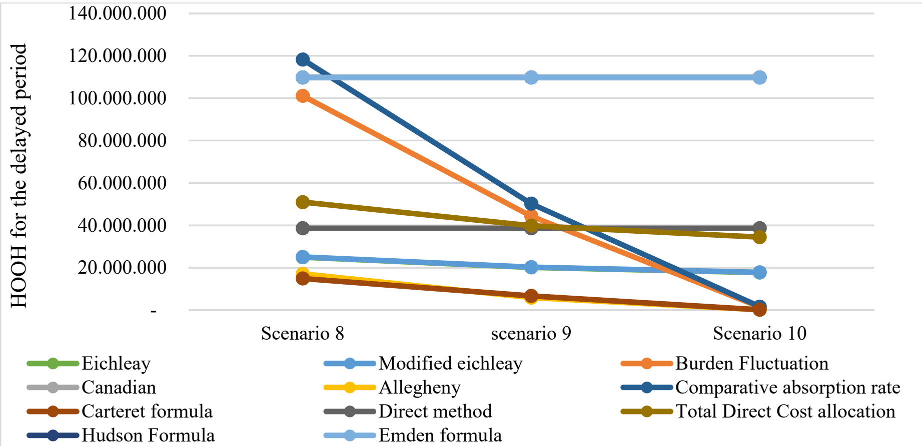

Fig. 3 HOOH trend lines for different scenarios of increase in no. of projects (Project1)

TABLE VI
SUMMARY OF HOOH IN SCENARIOS OF VARYING NUMBER OF PROJECTS (PROJECT1)

Formula	Scenario 8	Scenario 9	Scenario 10
Eichleay	24,936,969	20,132,599	17,697,204
Modified Eichleay	25,077,271	20,245,870	17,796,773
BFM	101,125,870	44,332,983	1,436,416
Canadian method	38,580,417	38,580,417	38,580,417
Allegheny formula	17,097,206	5,860,374	164,283
CAR	118,223,077	50,193,357	1,600,699
Carteret	14,886,005	6,697,469	165,626
Direct method	38,580,417	38,580,417	38,580,417
TDCA	50,927,260	39,818,582	34,450,923
Hudson	109,789,186	109,789,186	109,789,186
Ernstrom	17,773,468	25,573,842	22,480,232
Emden	109,789,186	109,789,186	109,789,186

This increasing trend shows the inability of these formulae to take into account the overhead expenses getting absorbed by the increased scope of work.

The second group of formulae includes burden fluctuation, Allegheny, and comparative absorption rate. These formulae depict a decrease in the unabsorbed overhead expenses with an increase in the scope of work within the same period of delay but, do not reach zero value even when the increment in scope of work justifies that period of delay. This decreasing trend shows that these formulae can factor the overheads getting absorbed by the increase in scope of work. However, where the delay is only because of the increased scope of work, these formulae do not give a zero value.

The third group of formulae includes Canadian, direct method, Hudson, and Emden formula. These formulae show a constant value in all scenarios, i.e. is not sensitive to the increment or decrement in the scope of work. Thus, these formulae give values based on delay period only. If the delay period is the same, these formulae would give a constant value and does not cater to HOOH getting absorbed by the increase in the scope of work.

2) Analysis by Varying Number of Projects during the Period of Delay

The second variable taken is the increase in no. of new projects undertaken during the period of delay. This variable has been taken to identify which formula takes in account of the overheads getting absorbed when a contractor is able to get new projects in the delay period of a project and which formula does not cater to this. Three more scenarios have been taken, in the 8th scenario, there has been no increase in the number of projects during the period of delay, in the 9th scenario one new project has been taken up, and in the 10th scenario two new projects have been taken up by the contractor during the delay period of the project. Input parameters like period of delay, the scope of work and monthly HOOH expenses have been kept constant in all scenarios, and the number of projects in the period of delay which changes the contractor's revenue during the actual period has been varied. Data for the scenarios are represented in Table V. Values for HOOH are calculated for each scenario of Project1 using all formulae as summarised in Table VI, and the trends for each formula are presented in Fig. 3.

From Fig. 3, it can be seen that the HOOH calculation formulae can be broadly categorized into two groups based on the trends that they depict with each scenario. Some of the trend lines are not visible because they are overlapping with other lines.

The first group comprises Eichleay, burden fluctuation, Allegheny, comparative absorption rate, Carteret, total direct cost allocation and Ernstrom methods. They show a falling trend in the value of HOOH value when a contractor undertakes new projects during the period of delay. This decreasing trend shows that these formulae can take into account the overheads getting absorbed by the increase in a number of projects.

The second group comprises of Canadian, direct method, Hudson, and Emden formula. All these formulae are giving a constant value irrespective of the variable that a new project has been taken in the period of delay or not. Thus, it can be said that these formulae are not taking into account the overhead expenses getting absorbed because of the new projects. However, when the number of days taken by a contractor to complete the additional scope of work is not considered to be an OCD and instead is taken as a revision in the planned duration of the contract, the results obtained are different. In such a case Eichleay, modified Eichleay and total direct cost allocation method shows a decreasing trend in the HOOH values as the scope of work within the project is increased and even reaches the zero value when the increase in scope completely justifies the period of delay of the project as shown in Fig. 4.

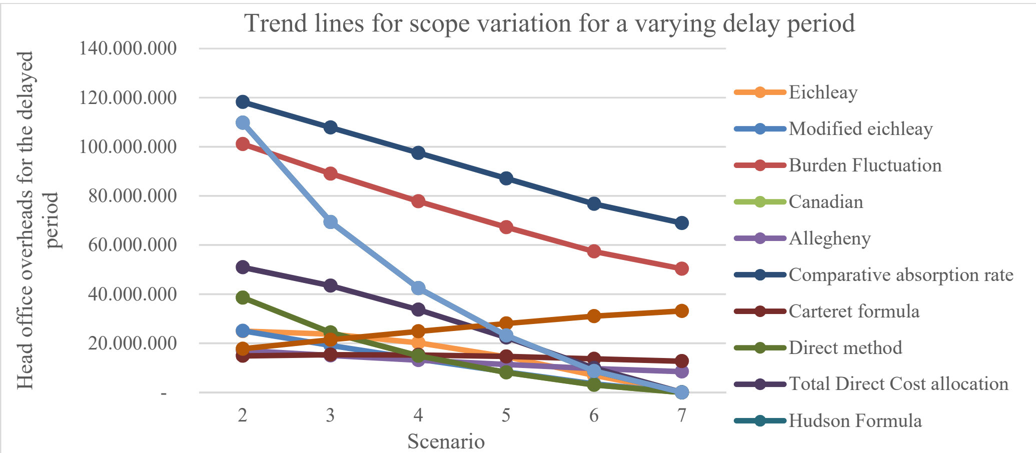

Fig. 4 Trend lines when OCD days are decreased with increase in scope of work.

Similar data were collected for three other projects of the same contractor and analysis was carried out. The second study undertaken was a building construction project, experiencing delay caused by both owner and contractor caused events. The contract value of the project was approximately INR 2000 million. The contract duration of the project was 60 months. The project was completed in 84 months (delay of approximately 40%). In this study, four scenarios have been considered where the scope of work has been changed. A scope increment of 10%, 20%, 30% and 40% has been considered in scenarios 11, 12, 13, and 14 respectively. Scenario 14 is the increment in the scope of work which justifies the fixed period of delay, i.e. an increment of scope by 40%. Throughout these four scenarios, the value of input parameters like actual monthly HOOH expense, a period of OCD, original contract value and original contract period have been kept constant. Amount of billing during the original and delayed period for each scenario has been varied in the same proportion as it was in the original case of the project. Contractor's revenue for the actual period has been varied with a change in scope of work

The third study undertaken was a sheet pile project, experiencing delay caused by both owner and contractor caused events. The contract value of the project was INR 800 million, and contract duration of the project was 13 months. The project was completed in 19 months (delay of approximately 46.5%). Six scenarios have been considered in the study of this project where the scope of work has been changed. In scenario 15, no change in scope of work has been taken considering the contractor gets no new project during the period of delay. Then, scope increment by 10% has been considered in the next four scenarios, i.e. total scope increment of 10%, 20%, 30% and 40% in scenarios 16, 17, 18 and 19, respectively. The last scenario is the increment in the scope of work which justifies the fixed period of delay, i.e. an increment of scope by 46.5%. Throughout these six scenarios, the value of input parameters like actual monthly HOOH expense, a period of OCD, original contract value and original contract period has been kept constant. Amount of billing during original and delayed period has been varied in the same proportion as it was in the original case of the project. Contractor's revenue for the actual period is varying automatically with a change in scope of work.

In this third study, further, three more scenarios have been taken, in scenario 21 there has been no increase in the number of projects during the period of delay (i.e., same as scenario 15), in scenario 22 one new project has been taken up and in scenario 23 two new projects have been taken up by the contractor during the delay period of the project. Input parameters like period of delay, the scope of work and monthly HOOH expenses have been kept constant in all scenarios and the number of projects in the period of delay which changes the contractor's revenue during the actual period has been varied.

The fourth study undertaken was a port construction project, experiencing delay caused by both owner and contractor caused events. The contract value of the project was INR 3000 million. The contract duration of the project was 48 months. The project was completed in 66 months (delay of approximately 37.5%). Four scenarios have been considered where the scope of work has been changed. A scope increment of 10%, 20%, and 30% have been considered in scenarios 25, 26, and 27 respectively. Scenario 28 is the increment in the scope of work which justifies the fixed period of delay i.e. an increment of scope by 37.5%. Throughout these four scenarios, the value of input parameters like actual monthly HOOH expense, a period of OCD, original contract value and original contract period has been kept constant. Amount of billing during original and delayed period has been varied in the same proportion as it was in the original case of the project. Contractor's revenue for the actual period is varying automatically with a change in scope of work.

The trends of HOOH values obtained by the scenario analysis of these three projects considering 18 new scenarios were similar to the trends obtained by the scenario analysis of project1.

IV. Conclusion

The study concludes that Eichleay, modified Eichleay, total direct allocation, Ernstrom method, Canadian, Direct, Hudson and Emden formula do not factor the HOOH getting absorbed due to increment in the scope of work when the OCD days are not changed accordingly. Use of Eichleay, modified Eichleay, total direct allocation and Ernstrom method to calculate HOOHs should be discouraged when the delay is due to increment in the scope of work without affecting the OCD days. In such situations, Burden fluctuation, Allegheny, and Comparative absorption rate method may be used since they factor the absorption of HOOH due to replaceable work available while calculating unabsorbed HOOH. It is in the best interest of the owner to negotiate with the contractor during the time of contract only, on the use these formulae in case of delay due to increase scope of work, to share the benefits of absorbed HOOH.

The reason behind the decrease in values given by Eichleay, modified Eichleay and total direct allocation with increase in scope of work when the OCD days are decreased simultaneously, is because of the dependency on the formulae on delay period. These formulae work only when the delay period because of the increased scope of work is not considered as OCD.

Canadian, Direct, Hudson and Emden formulas are fixed value formulas for the scenarios considered and depend directly on the duration of the delay period. Therefore, these formulae do not include a factor for the HOOH getting absorbed due to increment in the scope of work or contractor getting new projects during the period of delay. These formulae work on the logic that if there is a delay, the contractor should be compensated irrespective of its overheads remaining unabsorbed or not. The values given by Hudson and Emden formula are quite high because they incorporate the profit component also along with HOOH for the period of delay. The direct method and Canadian method are numerically the same methods as observed in all the scenarios considered.

Use of one formula may lead to a loss for a contractor or may create an extra burden on the owner. Further work needs to be done on analyzing the factors external to the contractor within the scenario analysis to understand them in respect of the HOOH costs. Such consideration may best cater to both parties instead of giving windfall gains to one factoring the shortcomings explained in the study. Authors also advocate the damages that need to be mitigated by contractors, and such measures should be factored in the formula computing unabsorbed HOOH.

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