



PRACTICES OF PRICE ADJUSTMENT IN SELECTED CONSTRUCTION PROJECTS

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ABSTRACT

Price adjustment affects all the stakeholders i.e. client, consultant and contractor. This research reveals the trend of the cost of components of construction i.e. labor, material, fuel, equipment etc., compare the different formulas of price adjustment and understand the view of client, consultant and contractor regarding price adjustment. Ten contracts commencing within 2010 A.D to 2019 A.D have been chosen. The four contracts have used FIDIC formula, five have used PPMO formula and one has used small works formula. Trend of cost of labor, bitumen, fuel has been analyzed for contracts using FIDIC formula and the trend of NRB index of labor, material and equipment has been analyzed for contracts using PPMO formula. The formula used in the contracts have been compared with other formulas under same circumstance that original formula was used. Questionnaire was distributed to the client, contractor and consultant's representative. On Contracts using FIDIC formula, the cost of labor can be predicted to increase in future. The cost of fuel and bitumen cannot be predicted as it is fluctuating with respect to time. Comparing the price adjustment factor using different formulas, it cannot be generalized that which formula could give minimum value of price adjustment.

Keywords—trend, price adjustment, index, cost

I. INTRODUCTION

1.1 Background

Nepal is a developing country. Lot of construction activities are undergoing and yet to be done. Infrastructure development is the frontline role player for which the equipped and efficient construction industry is most [1]. Uncertain economic environment is one of the main challenges for construction sector. Fluctuations in the costs of construction resources in today's volatile market makes difficult to execute construction projects due to significant losses or erosion of anticipated profits [1].

Construction is always considered as one of the high-risk business for stakeholders in the business [2]. The project owner, contractor, consultant, financiers, suppliers and even the service providers, everyone has their own perception of facing risk. Risk management is a vital element of the decision making in construction [3]. One of the many major risks and challenges construction industries facing, is the fact that the cost at completion of the projects are much higher than original contract prices. In the recent past, we have seen significant price escalation occurring not only with the basic construction materials but also the labor and fuel. This creates uncertainty among all parties involved in construction project. It is therefore very critical for owners and contractors to find ways to quantify and manage cost escalation on their projects.

In order to ensure the availability of sufficient funds to achieve the final goals within allocated cost and schedules to overcome the effect of fluctuation certain methods or contract clauses are devised to deal with uncertainty. The main purpose of the price adjustment clauses is to allow the contractors and clients to get the benefit of increases or decrease in prices. Price adjustment clauses in construction contracts are intended to reduce the financial risk to project owners and contractors if the input costs rise or fall sharply during construction when the contract period is long. Adjustment provision in a contract also lowers the risk of contractors underestimating cost increases, and

later experiencing financial difficulties and defaulting on their obligations [4].

According to "Price Adjustment Guidance on Procurement 2018" of ADB, price adjustment provisions are meant to give protection to the contractor against price escalation. Cumulative impacts of price escalation can be substantial in contracts with long delivery and completion periods. Contracts that include large, price-sensitive materials or commodities can also experience abrupt and significant increases in price. Price adjustment may also pass on savings to the borrower (or grant recipient) due to the downward movements in price. Price adjustment provisions include formulas designed to address problems, and can protect both the borrower and contractors from price fluctuations. Despite concerns that they may lead to budget uncertainties, price adjustment formulas will estimate the actual cost implications that will be encountered. They use indexes that can be used for cost projection [5-6].

In Nepal, both Nepal Government funded projects and donor funded projects are in implementation. PPA 2063 and PPR 2064 provides legal framework for procurement by Nepal Government funded projects. Based upon act and regulation, public procurement monitoring office prepares standard bidding document for different works, prepare guidelines and monitors the procurement activity. Public procurement regulation 2064 has a provision for price adjustment in rule 119. Generally, in Nepal government projects, the contracts having the contract duration greater than 12 months have provision of price adjustment. According to "Price Adjustment Guidance on Procurement 2018" of ADB, price adjustment provisions may also be used in consulting and non-consulting service contracts, to adjust remuneration rates for the effects of inflation for contracts with duration of 18 months or more [7-10].

1.2 Objective

The objectives of this research is to find the trend of cost of components of construction (labor, material, equipment, fuel etc.) in selected construction contracts, to compare value of price

adjustment factor of selected contracts using different price adjustment formulas and to understand the views of client, contractor and consultant on price adjustment.

Major scope of this research is in construction sector. This research is mainly focused on understanding the adjustment of price accordingly throughout the construction period of selected contracts.

This research is based on the contracts which have the clause of price escalation and have crossed two years period in construction under ‘Government of Nepal, Department of Roads, Project directorate ADB, Kathmandu’, ‘Road Division Butwal, Rupandehi’, Mid-hill Project east sector and Bridge Project Western Sector No.3 Banke.

II. METHODOLOGY

This research focuses to analyze some specific contracts’ price adjustment trend. So deliberate/ judgmental or purposive sampling has been used as the sample of contracts under study is selected contracts. In this type of sampling the contracts under DOR having price adjustment provisions have been selected deliberately. The total population of the client, contractor and consultants related to the selected contracts has been taken for the research.

Ten projects have been chosen for this research. They are Nepalgunj-Kohalpur Road Package-1, Nepalgunj-Kohalpur Road Package-2, Bhairahawa-Lumbini-Taulihawa Road Project, PupalalMidhill Highway Project East Sector, and Design & Build of RaptiNadi Bridge, GauriKhola Bridge, UngridaKhola Bridge Inguriya River Bridge and Chainpur-Khandbari Road Project. The trend of price adjustment of various components of construction i.e. labor, material, equipment, fuel etc. in selected contracts of DOR has been analyzed and price adjustment factor of selected contract using different formulas have been compared. Descriptive, quantitative and analytical research design have been used. And for knowing the view of client, contractor and consultant qualitative Research design have been used.

Primary data have been collected via questionnaire given to client, contractor and consultants involved in the project. The secondary data have been collected through the interim payment certificates and contract documents of the selected contracts from ‘Department of Roads, Project directorate ADB, Kathmandu’, ‘Road Division Butwal, Rupandehi’, Mid-hill Project east sector and Bridge Project Western Sector No.3 Banke and through different contractors and consultants. Data have also been collected from price index published by NRB.

After collection of data, the data has been checked for validity and reliability and classified into different categories. The cost/index of material, equipment and labor has been separately noted and each of them has been plotted on graph where x-axis is duration and y-axis are cost/index. The trend of the material, equipment, labor, fuel cost/index varies during the construction period of each selected contract have been analyzed. The data have been used to compare the price adjustment factor of selected contract using different formulas. Each value of price adjustment calculated from the formula mentioned in the price adjustment clause of contract and the value of price adjustment calculated from formula other than that mentioned in price adjustment clause has been compared.

Data collected from questionnaire have been used to know the view of client, consultant and contractor regarding price adjustment.

III. RESULTS

3.1 Trend of Cost of Components of Construction using FIDIC Formula

FIDIC formula have been used in the contracts namely Nepalgunj-Kohalpur Road Package-1, Nepalgunj-Kohalpur Road Package-2, Bhairahawa-Lumbini-Taulihawa Road Project and Construction of Prestressed RCC bridge over Tinau River. The cost of components of construction in each IPC is taken starting from the base date and graph is plotted.

3.1.1 Labor Cost Trend

The cost of labor has been taken from the district rates of the respective district on which the project is implemented. The graph has been plotted of all four contracts with date of IPC in x-axis and labor cost in y-axis. The graph below show the actual trend of the cost of labor in Nepalgunj Kohalpur Road Package-1 using FIDIC formula for price adjustment.

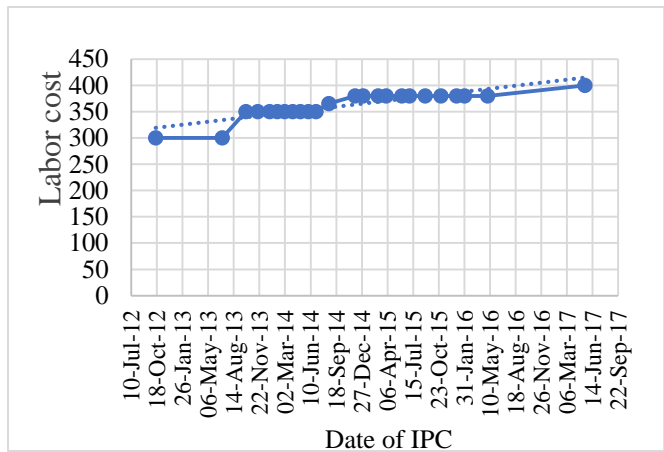


Fig. 1. Labor Cost trend of Nepalgunj Kohalpur Road Package-1

Analyzing the graph of all four contracts it has been observed that the labor cost has increased with respective to time in every contract. Labor cost has increased by 33.33 % in Nepalgunj-Kohalpur Road Package-1, 21.67% in Nepalgunj-Kohalpur Road Package-2, 29.21% in construction of Prestressed Bridge over Tinau River and 18.17% in Bhairahawa-Lumbini-Taulihawa Road project up to the last IPC date

3.2 Fuel Cost Trend

The cost of fuel has been taken from the district rates of the respective district on which the project is implemented.

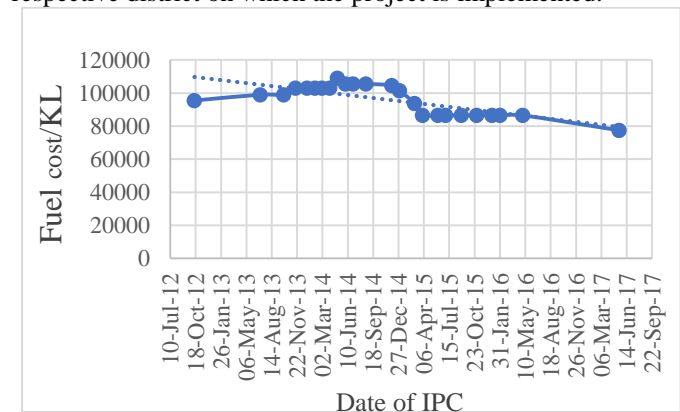


Fig. 2. Fuel Cost trend of Nepalgunj Kohalpur Road Package-1

The graph has been plotted of all four contracts with date of IPC in x-axis and fuel cost in y-axis. The graph below reveals the actual trend of the cost of fuel in Nepalgunj, Kohalpur Road Package-1 using FIDIC formula for price adjustment. Analyzing the graph of all four contracts it is seen that the fuel cost has fluctuated more with respect to time. In Nepalgunj-Kohalpur Road Package-1, it can be seen that base value of fuel was 95500/KL in October 2012 and cost has increased up to 109000/KL in April 2014 and again went on decreasing to 77500/KL in May 2017. The cost of fuel has reduced by 23.22% up to last IPC. In Nepalgunj Road Kohalpur Package-2, the cost of fuel has increased by 4.71% up to last IPC. In construction of Prestressed RCC bridge over Tinau River, the cost of fuel has reduced by 5.81% up to last IPC date. In Bhairahawa-Lumbini-Taulihawa Road Project the cost of fuel has increased by 34.93% up to last IPC date. So, it cannot be predicted accurately whether the fuel cost increase or decrease in a contract over time.

3.3 Bitumen Cost Trend

The cost of Bitumen has been taken from the district rates of the respective district on which the project was implemented. The graphs below show the actual trend of the cost of bitumen in the three contracts using FIDIC formula for Price adjustment. As bitumen is not used in bridge construction so Tinau River Bridge has not been considered.

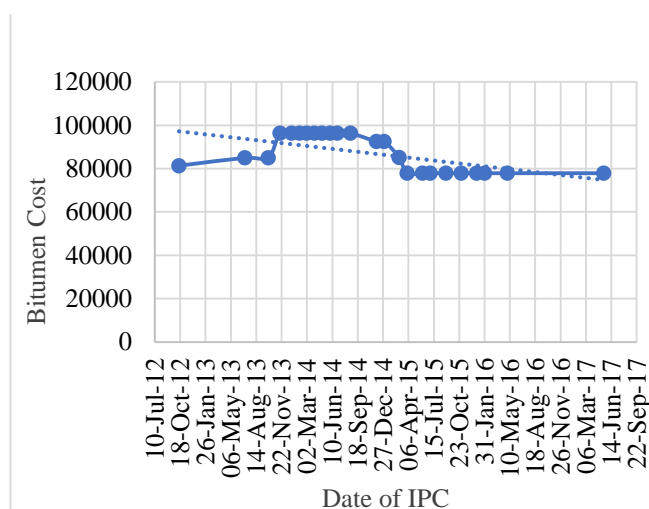


Fig. 3. Fuel Cost trend of Nepalgunj Kohalpur Road Package-1

By analyzing the four contracts, it can be seen that the bitumen cost has fluctuated with respect to time. In Nepalgunj Road Kohalpur Package-1, base value of bitumen is Rs 81350, peak value is 96400 and value at last date of IPC is 77900. The cost of bitumen has reduced by 4.24% up to last IPC. Similarly, in Nepalgunj Road Kohalpur Package-2, the cost of bitumen has reduced by 7.8% up to last IPC date. In Bhairahawa-Lumbini-Taulihawa Road Project the cost of bitumen has increased by 18.13% up to last IPC date. It can be seen that the bitumen cost cannot be predicted in more accurate way.

3.4 Trend of Cost of components of construction on Contracts using PPMO formula

PPMO formula have been used in 5 construction contracts under study. Three inputs labor, material and equipment index are taken from NRB economic bulletin and publications. The base dates of these contracts are:

Puspatal Midhill Highway Project East Sector: 7 June 2015, Design & Build of Rapti Nadi Bridge: 10 April 2016, GauriKhola

Bridge: 12 March 2017, Ungrida Khola Bridge: 7 May 2017, Inguriya River Bridge: 12 March 2017

All the contracts study period is before July 2019. So, the trend of labor, material and equipment index from June 2015 to present has been analyzed to know how the construction input index is changing.

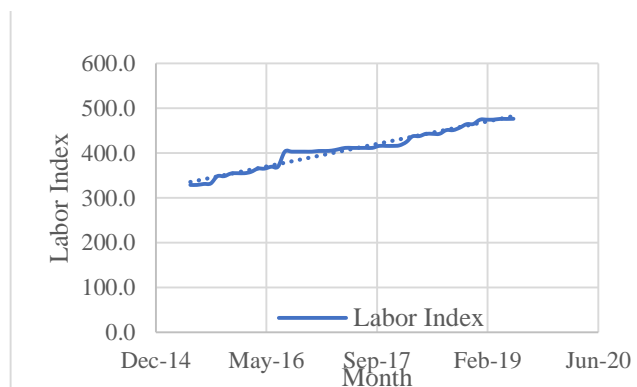


Fig. 4. Labor Index trend

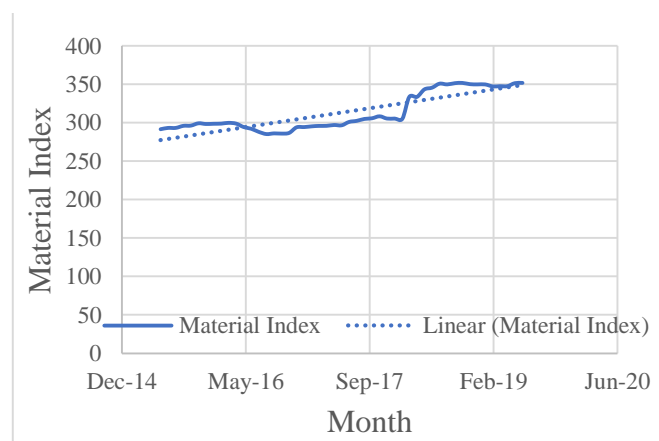


Fig. 5. Material Index trend

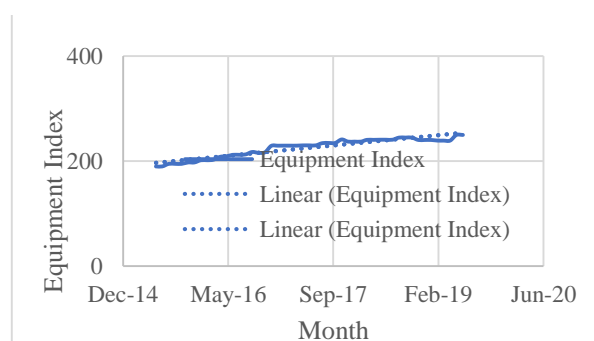


Fig. 6. Equipment Index trend

It is found that labor index has increased every month from June-2015 to June-2019. Labor index has increased by 44.86% during four years. Material index has increased from month from June-2015 with value 291.6 to March 2016 with value 299.9 and decreasing up to October 2016 with value 285.9 and then increased to June-2019 with value 359.47. Material index has increased by 20.66% during four years. Equipment index has increased from month from June-2015 with value 190.1 to October 2018 with value 245.04 and decreasing up to April 2019 with value 239.3 and then increased up to June-2019 with value 250.07. Equipment index has increased by 31.54% during last four years.

3.5 Comparison of Price Adjustment Factor using different formulas

Ten contracts are chosen for this research. The IPC of each contract is taken and Original Price Adjustment Factor calculated in contract is compared with other formulas. In our study contracts having price adjustment calculation using FIDIC formula is compared with PPMO formula and Small works formula. Contracts using PPMO formula is compared with Small works formula and vice versa. The details of Nepalgunj Kohalpur Road Package-1 are

Bid Opening date: 11-November-2012

Base Date: 13-October-2012

Original formula used is FIDIC formula:

$$Pf = A + b \frac{Ln}{Lo} + c \frac{Fn}{Fo} + d \frac{Bn}{Bo} + e \frac{On}{Oo} \quad (1)$$

,where A=0.15, b=0.10, c=0.10, d=0.35, e=0.30

Ln, Fn, Bn, On are the current cost of labor, fuel, bitumen and others indices (consumer price index) 49 days before each IPC. Lo, Fo, Bo, Oo are base value of labour, Fuel, Bitumen and Others index (consumer price index).

Small works formula is:

$$Ps = Ac + b \frac{Lmc}{Lmo} \quad (2)$$

Where Ac=0.15 and Bc=0.85 Lmc is consolidated consumer price index at current IPC and Lmo is consolidated consumer price index at base date. From NRB economic bulletin was taken the value of Lmo for the base date and Lmc for 49 days before IPC date. Lmo is 180.8 for the base date. PPMO formula is taken as $Pp = a + b \frac{Ln}{Lo} + c \frac{Mn}{Mo} + d \frac{En}{Eo}$ (3), where Ln, Mn, En are the NRB index of Labor, Material and Equipment respectively taken 49 days before IPC date and Lo, Mo, Eo are the base index of Labor, Material and Equipment respectively. Apart from this, the coefficient of b, c and d are not known. Generally, the limits are set by the employer for the value of b, c and d as:

$$a=0.15, b=0.15 \text{ to } 0.25, c=0.30 \text{ to } 0.40, d=0.20 \text{ to } 0.30$$

Where the sum of a, b, c and d should be equal to 1.

The value of b, c, d has been chosen with three combinations and calculate the price adjustment factor using PPMO formula.

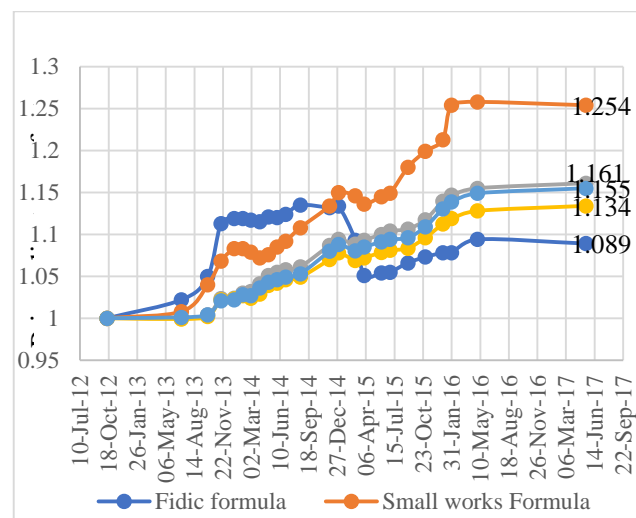


Fig. 7. Comparison of Price Adjustment using different formulas in Nepalgunj-Kohalpur Road Package-1

Pp1 has been calculated using coefficients b=0.25, c=0.40, d=0.20 where coefficient of labor is Maximum, Material is maximum and Equipment is minimum. In simpler form combination can be denoted as Lmax, Mmax, Emin. Pp2 has been calculated using coefficients b=0.15, c=0.40, d=0.30 (Lmin, Mmax, Emax). Pp3 has been calculated using coefficients b=0.25, c=0.30, d=0.30 (Lmax, Mmin, Emax).

By application of FIDIC formula the price adjustment has increased by 8.9% up to last IPC, Small works formula has shown increment up to 25.4%. PPMO formula using coefficients Lmax, Mmax, Emin (Pp1) has shown increment up to 16.1%, PPMO formula using coefficients Lmin, Mmax, Emax (Pp2) has shown increment up to 13.4%, PPMO formula using coefficients Lmax, Mmin, Emax (Pp3) has shown increment up to 15.5%. The comparison of Price Adjustment using original formula and other than original formulas have been done in all ten contracts.

3.6 Overall Comparison of Price Adjustment Factor using different formulas

The comparison of Price Adjustment using original formula and other than original formulas have been done in all ten contracts. The increment up to last IPC have been taken out using different formulas.

a) Nepalgunj Kohalpur Road Package-1

Base date: 13th October 2012

Last IPC date: 15th May 2017

Original formula used: FIDIC formula

Change in Price Adjustment factor using FIDIC formula=8.90%, Small works formula=25.40%, PPMO formula using coefficient Lmax, Mmin, Emax=16.00%, Lmin, Mmax, Emax=13.40%, Lmax, Mmax, Emax=15.50%

b) Nepalgunj Kohalpur Road Package-2

Base date: 13th October 2012

Last IPC date: 1st October 2015

Original formula used: FIDIC formula

Change in Price Adjustment factor using FIDIC formula=11.70%, Small works formula=11.80%, PPMO formula using coefficient Lmax, Mmin, Emax=10.10%, Lmin, Mmax, Emax=8.00%, Lmax, Mmax, Emax=9.20%

c) Bhairahawa-Lumbini-Taulihawa Road Project

Base date: 22nd September 2016

Last IPC date: 31st Jul 2019

Original formula used: FIDIC formula

Change in Price Adjustment factor using FIDIC formula=11.36%, Small works formula=8.80%, PPMO formula using coefficient Lmax, Mmin, Emax=16.99%, Lmin, Mmax, Emax=16.70%, Lmax, Mmax, Emax=16.18%

d) Tinau River Bridge

Base date: 5th June 2015

Last IPC date: 28st April 2019

Original formula used: FIDIC formula

Change in Price Adjustment factor using FIDIC formula=21.77%, Small works formula=14.53%, PPMO formula using coefficient Lmax, Mmin, Emax=18.79%, Lmin, Mmax, Emax=18.01%, Lmax, Mmax, Emax=19.95%

e) Gauri River Bridge

Base date: 12th March 2017

Last IPC date: 5th July 2019

Original formula used: PPMO formula
 Change in Price Adjustment factor using formula using PPMO formula using coefficient Lmax, Mmax, Emin=12.72%, Small works formula=11.57%, PPMO formula using coefficient Lmax, Mmin, Emax=13.71%, Lmin, Mmax, Emax=12.83%

f) *Ungrida Khola Bridge*

Base date: 7th May 2017
 Last IPC date: 12th July 2019
 Original formula used: PPMO formula
 Change in Price Adjustment factor using formula using PPMO formula using coefficient Lmid, Mmax, Emid=12.80%, Small works formula=9.22%, PPMO formula using coefficient Lmax, Mmin, Emax=13.20%, Lmin, Mmax, Emax=12.40%, Lmax, Mmax, Emin=12.23%

g) *Inguriya Khola Bridge*

Base date: 12th March 2017
 Last IPC date: 13th July 2019
 Original formula used: PPMO formula
 Change in Price Adjustment factor using formula using PPMO formula using coefficient Lmax, Mmin, Emax=13.71%, Small works formula=8.85%, PPMO formula using coefficient Lmin, Mmax, Emax=12.83%, Lmax, Mmax, Emin=12.72

h) *Rapti River Bridge*

Base date: 10th April 2016
 Last IPC date: 9th July 2019
 Original formula used: PPMO formula
 Change in Price Adjustment factor using formula using PPMO formula using coefficient Lmax, Mmin, Emax=21.83%, Small works formula=14.22%, PPMO formula using coefficient Lmin, Mmax, Emax=21.66%, Lmax, Mmax, Emin=22.57%

i) *Chainpur-Khandbari Road Project*

Base date: 10th May 2011
 Last IPC date: 1st Sep 2015
 Original formula used: small works formula
 Change in Price Adjustment factor using Small Works formula=31.85%, PPMO formula using coefficient Lmax, Mmin, Emax=25.00%, Lmin, Mmax, Emax=19.80%, Lmax, Mmax, Emax=23.90%

j) *Midhill Road Project*

Base date: 7th June 2015
 Last IPC date: 24th May 2019
 Original formula used: PPMO formula
 Change in Price Adjustment factor using Small Works formula=14.98%, PPMO formula using coefficient Lmid, Mmid, Emin=17.91%, Lmin, Mmid, Emax=17.81%, Lmax, Mmin, Emin=18.62%, Lmin, Mmax, Emin=17.20

It is found that the contracts whose base date is before 2015, The price adjustment factor calculated by FIDIC formula is lowest, followed by PPMO formulas and Price adjustment factor obtained by small works formula is highest. And in the contracts whose base date is after 2015, the price adjustment factor calculated by FIDIC formula is highest, followed by PPMO formulas and Price adjustment factor obtained by small works formula is lowest. Thus, it cannot actually be defined which formula gives more value of price adjustment factor. It depends upon the condition such as time, index and cost.

In PPMO formula if the coefficients are set by the client, the price adjustment factor using coefficients of labor “Lmax” is more likely to give higher value of Price Adjustment factor than using “Lmin”.

3.7 *Knowing the views of Client, Contractor and consultant regarding Price Adjustment*

Questionnaire survey has been conducted for understanding effect of price Adjustment on Client, Contractor and Consultant. The average percentage of respondents are 76.93%

TABLE I. SURVEY DATA RESPONSE ON

	Asked	Replied	% Replied	Average % of reply
Clients	65	51	78.46	76.93
Contractors	56	43	76.78	
Consultants	45	34	75.56	

3.7.1 *Application of Price Adjustment formula in construction contract*

As per the response of respondent the Relative Importance Index of Client is 58.04%, Consultant is 58.24% and that of contractor is 51.24%, which means most of them have applied price adjustment formula in contract.

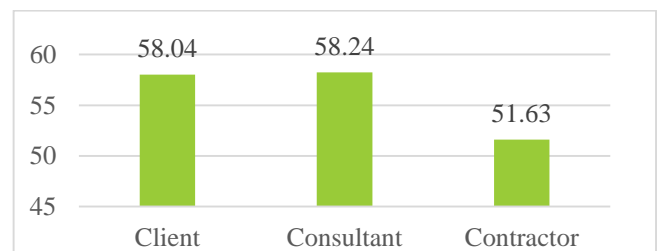


Fig. 8. RII of Application of Price Adjustment formula in construction contract

3.7.2 *Familiarity with price Adjustment Formula*

Most of the clients are familiar with PPMO formula. 84.31% of Client are most familiar with PPMO formula, 11.76% with FIDIC formula and 1.96% with Small Works formula. Similarly, 70.59% of consultants are most familiar with FIDIC formula and 29.41% are familiar with PPMO formula. 93.02% of Contractors are most familiar with PPMO formula, 6.98% of contractors are more familiar with FIDIC formula and none of the contractors are familiar with Small Works formula.

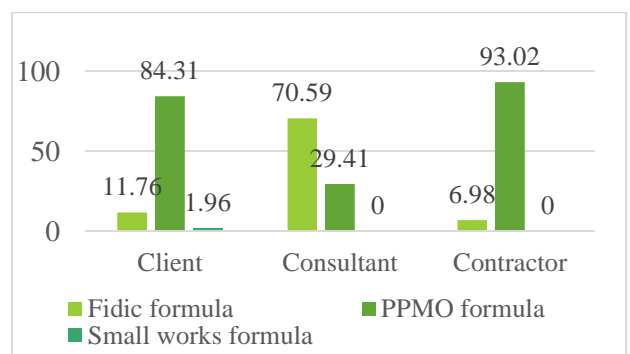


Fig. 9. Familiarity of Price Adjustment formula

3.7.3 Application of Price Adjustment formula in construction contract

As per response 78.43% of Client Prefer to use PPMO formula in construction contracts, 19.61% prefer to use FIDIC formula and 1.96% preferred to use Small works formula. 55.88% Consultants prefer to use PPMO formula, 44.12% of them prefer to use FIDIC formula and none of them prefer to use Small Works formula. Similarly, 72.09% of the contractors prefer to use PPMO formula, 25.58% of them prefer to use FIDIC formula and 1.96% of them prefer to use Small Works formula. It is seen that most of the respondents preferred to use PPMO formula in construction contracts.

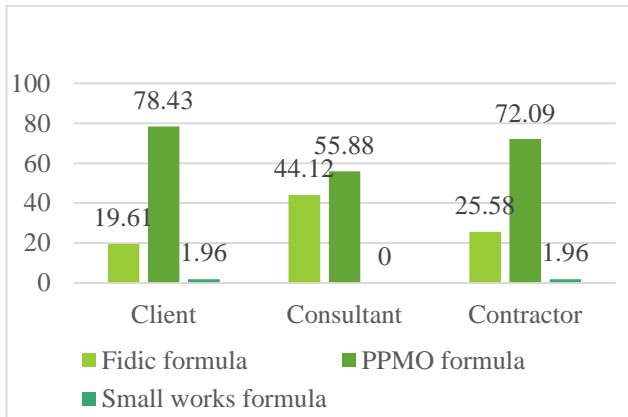


Fig. 10. Preference of use of Price Adjustment Formulas

3.7.4 Sensitiveness of Price Adjustment formula in variation of inputs

As per response, 49.02% of Client believe that FIDIC formula is more sensitive in relation to variation of the inputs. 29.41% believe that Small Works formula is sensitive, 21.57% believe that PPMO formula is sensitive. 47.06% of the consultant believe that Small Works formula is more sensitive, 17.65% of them believed that PPMO formula is more sensitive and 11.76% believe that FIDIC formula is more sensitive.

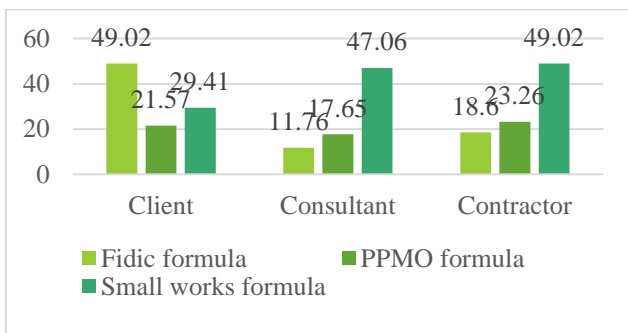


Fig. 11. Familiarity of Price Adjustment formula

3.7.5 Limitation of Range of Coefficients in Price Adjustment formulae

The relative important index of Client (74.12), Consultant (73.13) and Contractor (63.72%) show that the range of coefficients used in price adjustment formula should be limited by the employer.

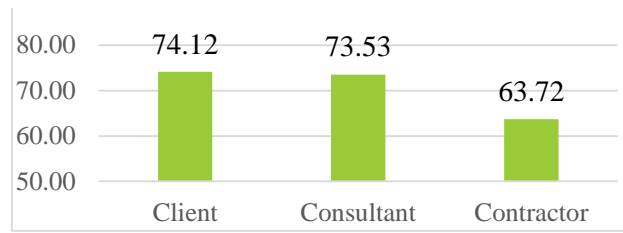


Fig. 12. RII of Limitation of Range of Coefficients in Price Adjustment formula

3.7.6 Relation of Price Adjustment Factor and Initial completion date of Contract.

After the initial completion date of contract has crossed and extension of time has been done, the price adjustment factor should be calculated based on the indices before and up to the initial completion date only. For this statement views of client, consultant and contractor are taken and RII index as calculated is 65.10% of client, consultant is 75.88% and contractor is 58.60%.

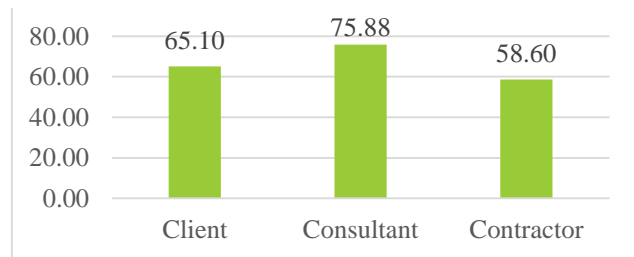


Fig. 13. RII of Relation of Price Adjustment Factor and Initial Completion date of Contract.

Price adjustment should be provided after the initial completion date of contract also. The RII index of client is 67.06%, consultant is 75.88% and the contractor is 80.47%. Contractor has relatively high RII as Price adjustment affect their cost of project. Overall, the RII values favor the statement.

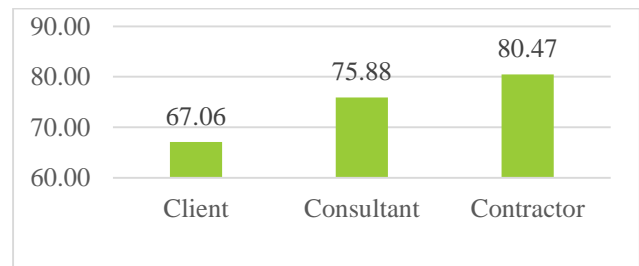


Fig. 14. RII of Relation of Price Adjustment Factor and Initial Completion date of Contract.

3.7.7 Effect of inclusion of Price Adjustment Clause

The main effect of inclusion of Price adjustment clause in contract is "Increase in Project cost" with RII value 0.7529 for client 0.8706 for consultant and 0.8140 for contractor. The combined RII value is 0.8047 which ranks 1. Similarly, from the combined ranking 'Maintain cashflow problem' is ranked 2 with combined RII value 0.7422. "Minimize risk of project" is ranked 3 with combined RII value 0.7313. "Reduce conflict between contractor and Client" is ranked 4 with RII value 0.7281 and "Completion of Project on time" is ranked 5 with combined RII value 0.6328.

3.7.8 Factors affecting Price Adjustment

The main Factor Affecting Price adjustment factor is Weightage of coefficient proposed by bidders with rank 2 and RII

value 0.8078 for client 0.8706 for consultant and 0.8791 for contractor. The combined RII value is 0.8484 which ranks 1. Similarly, from the combined ranking "Price Adjustment Formula used in the contract" is ranked 2 with combined RII value 0.8234. "Price fluctuations in market" is ranked 3 with combined RII value 0.8172. "Limits of coefficients set by the client" is ranked 4 with RII value 0.7438. Overall ranking may be different from individual ranking which means view of individual is different but as a whole it may make different meaning.

IV. CONCLUSION

In contracts using FIDIC formula, the cost of labor is increasing with respect to time. It is more predictable that labor cost will increase in future. The cost of bitumen and fuel are unpredictable as the cost is fluctuating more with respect to time. In contracts using PPMO formula the index of Labor, Material and Equipment is used. The index of labor increase with time and it is more predictable than Material and Equipment index as they are fluctuating with respect to time.

Comparing the price adjustment factor using different formulas it can be seen that the value of price adjustment factor using different formulas are different. Also, it can be seen that during the course of time the price adjustment factor calculated using different formulas is different. Thus, it cannot be generalized that which formula could give minimum value of price adjustment. It depends upon the condition such as time, index and cost. As most of the respondents preferred to use PPMO formula, it is suggested to use PPMO formula in the construction contracts.

In PPMO formula under the limits set by the client, if the coefficient of labor is chosen maximum it is likely that price adjustment factor would be more.

After the initial completion date of contract has crossed and extension of time has been done, Price adjustment factor should be calculated based on the indices before and up to the initial completion date only. Price adjustment should be provided after the initial completion date of contract also.

V. REFERENCES

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