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Abstract

One of the wide ranging problems which construction industry is facing is the fluctuation in prices of Construction inputs which is causing most of the projects to be completed at sums much higher than the original contract prices. To overcome the effect of price fluctuations, certain methods or contract clauses are desired to deal with this uncertainty. The main purpose of the price adjustment clauses is to allow the contractors and clients to adjust the increase or decrease in prices. In addition to this, it also encourages competitive bidding. The objective of this research study is to make comparison of different price adjustment formulae and techniques being used for price adjustment in construction contracts (Road) in Nepal. The study was undertaken via secondary data collected from ADB projects, World bank projects, Midhill highway and RIP projects under department of Road whose construction were started after 2014 and their construction progress was more than 80% completed accordingly (22 projects) were identified and analyzed. Similarly, diagnostic survey was done among 10 contractors working on ADB Road projects to identify how contractors load premium risk in bid price while price adjustment clause is not provided in construction contract.
Findings demonstrate that amount of price adjustment is dependent on type of formula (FIDIC Harmonized, MDB Harmonized and PPMO) being used for the price adjustment in construction contracts. The study also identifies the ratio of price adjustment to estimated amount and ratio of price adjustment to total payment amount. Finally, based on the analysis of the results, comparison is made for different price adjustment formulas used in road contracts and change in bid price in a contract when price adjustment clause is applicable and not applicable is calculated. Results shows that Contractors add risk premium in bid price if price adjustment clause is not applicable. Similarly, amount of price adjustment is higher in Contracts using MDB harmonized formula (small contract) than FIDIC Harmonized formula(large contract) and PPMO formula.

Keywords

Price Adjustment, Fidic, Contract, Projects, ADB, MDB, PPMO

1. Introduction

Construction Industry and Construction activities are regarded as the backbone of economic and social growth as 70 % of the gross capital formation is contributed by this sector[1]. In Nepal, this industry contributes over 8 % of GDP and has the growth rate of more than that of the nation average[1]. It can be considered as a source of generating the employment for thousands and millions of unskilled, semi-skilled and skilled persons. It also plays a very important role in generating revenues in both formal and informal sector of economy.

Construction is always considered as one of the high risk business for stakeholders in the business[2]. The Project owner, contractor, consultant, financers, 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, it is seen that significant price escalation occurs 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. In addition to this, it also encourages competitive

bidding 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. If a contractor knows at the bidding stage that payments for his work will be periodically indexed, it is not needed to add a premium to the bid price for possible cost increases during construction. This reduces risk of losing the contract by adding the premium. Adjustment provision in a contract also lowers the risk of contractors underestimating cost increases, and later experiencing financial difficulties and defaulting on their obligations.

The Provisions of price adjustment on account of increase or decrease in cost of goods and services in construction contracts are practiced all over world to have more realistic competitive bids and execution of contracts on equitable and just manner. Price of goods and labor are highly variable due to fluctuations in the currency market. Public procurement act 2063 and public procurement regulation 2064 provides legal framework for procurement. 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. Most of the projects in Nepal either funded by Government of Nepal or donor funded projects longer than twelve month has a provision of price adjustment. Road Construction sector is one of the largest sectors in Nepal. Nepal has total road network of 85,037 Km comprised of 29,639 Km road constructed and being maintained by Department of Road (DOR) and 58,398 Km road constructed by Department of Local Infrastructure Development and Agricultural Road (DOLIDAR) and Local bodies[4].Huge budget 1.35 trillion is allocated for Road sector in fiscal year 2018/2019. Average cost of bituminous pavement in Nepal is Rs 2 crore per km[4]. The major physical activities and scope of DOR are maintenance, rehabilitation, upgrading and new construction of Strategic road network [5].

2. Literature Review

Price escalation is the upward movement of prices and can be factored in into a contract. It goes beyond what is expected, price escalation can affect a contractor's cash flow and lead to delays in construction and lower quality work[6].

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 period. Contracts that include large, price-sensitive materials or commodities can also experience abrupt and significant increases in price. Bidders will factor in the risk of price escalation when preparing their bid, depending on the contract specified in the bidding document.

1. In a fixed-price contract, bidders will factor in the aggregate financial risk associated with price escalation in their bids.

2. In a non-fixed price contract, a price adjustment formula is used to estimate price escalation.

Price adjustment provisions include formula designed to address problems, and can protect both employer and contractor from price fluctuations. Price adjustment formulas allow contractors to offer more realistic prices at the time of bidding[6].

2.1 Examples of Price adjustment formula from the standard bidding document (SBD) of Asian Development Bank (ADB) for goods, works and plants

SBD	Reference	Clause	formula
Large work	FIDIC MDB 2010	GCC 13.8	Pn = a+b(Ln/Lo)+c(En/Eo)+d(Mn/Mo)+.........

Table 1: For Large Works

Where
"Pn" is the adjustment multiplier to be applied to the estimated contract value in the relevant currency of the work carried out in period "n", this period being a month unless otherwise stated in contract data.

"a" (default value is set at 0.15) is a fixed coefficient, stated in the relevant table of adjustment data, representing the non-adjustable portion in contractual payments.

"b", "c", "d" are coefficient representing the estimated proportion of each cost element related to the execution of the works as stated in the relevant table of adjustment data. Such tabulated cost element may be indicative of resources such as labor, equipment and materials. (a+b+c+d+.....=1)

"Ln", "En", "Eo", "Mo" are the current cost indexes or reference prices, expressed in the relevant currency of

paymenet, each of which is applicable to the relevant tabulated cost element on the date 49 days prior to the last day of period (to which payment certificate relates)

"Lo", "Eo", "Mo" are the base cost indexes or reference prices, expressed in the relevant currency of payment, each of which is applicable to the relevant tabulated cost element on the base data.

SBD	Reference	Clause	formula
Small	MDB	GCC 54.1	Pc= Ac+ Bc (Imc/Ic)
Work	harmonized		

Table 2: For Small Works

Where
Pc is the adjustment factor for the portion of the contract price payable in a specified currency.

Ac and Bc are coefficients specified in the particular condition of contract, representing the non-adjustable(usually 0.10 to 0.20) and adjustable portions, respectively, of the contract price payable in that specific currency "c". (Ac+ Bc=1)

Imc is a consolidated ibdex prevailing at the end of month being invoiced and Ioc is the same consolidated index prevailing 28 days before bid opening for inputs payable, both in the specific currency "c".

Bidding documents shall state either that (i) bid prices will be fixed or (ii) that price adjustments will be made to reflect any changes (upwards or downwards) in major cost components of the contract, such as labor, equipment, materials and fuel. Price adjustment provisions are usually not necessary in simple contracts involving delivery of goods or completion of work within eighteen months, but shall be included in contract which extends beyond eighteen months[7].

Prices may be adjusted by the use of a prescribed formula (or formulae) which breaks down the total price into component that are adjusted by price indices specified for each component or, alternatively, on the basis of documentary evidence (including actual invoices) provided by supplier or contractor. The use of the formula method of price adjustment is preferable to that of documentary evidence.

Public Procurement regulation 2064 has a provision for price adjustment in rule 119. Under sub rule 119(1), a public entity shall set forth in the procurement contract that price adjustment may be made.

After preparing a cost estimate, cost estimate shall, for the purpose of budget management, be prepared also including 10% for price adjustment contingency, 10% for physical contingency and vat as required (public procurement regulation, 2064).

The price adjustment formula introduced by FIDIC in 1999 and adopted by public procurement monitoring office in standard bidding document is mentioned in equation in its generalized form.

$$Pn= A + b\, Ln/Lo + c\, Mn/Mo + dEn/Eo + \dots \dots \dots$$
Where,
"Pn" is the price adjustment factor for the work carried out in the period "n".

"A" "is a constant or the non-adjustable portion of price adjustment factor to be specified in Appendix-to bid, representing the non-adjustable portion of the contract price

"b, c, d" are coefficients or weightages of the order 0.xx (i.e., fractions having two significant digits) for each specified element of adjustment in the contract. The sum of a, b, c, d etc. shall be one

"Lo, Mo, Eo" are the base date indices for specified (adjustable) elements

"Ln, Mn, En, ... "are the current date indices of the specified (adjustable elements for the period "n".

The projects in which FIDIC Harmonized formula is used, construction inputs are breakdown into (labor, equipment, materials etc). The materials are also breakdown into (cement, bitumen) etc. In PPMO formula, Construction inputs are breakdown into (labor, equipment, fuel and material). There is no breakdown of materials. In MDB formula, no breakdown of construction input is done.

Price adjustment formula comprise fixed or non-adjustable cost components. Each cost components has a coefficient or weight that is calculated based on its proportion value to the total contract amount as per engineer's estimate. A price index is used to estimate the periodical adjustment of unit price of each cost component included in the formula. The fixed portion of price adjustment formula is calculated based on estimates of overhead cost, profit level and price contingencies. It may also include other cost component over which the contractor has reasonable control, a stable price trend, such as costs for rental equipment and miscellaneous materials and the cost components that are strictly regulated[6].

The adjustable component covers major cost component of the contract such as labor, equipment, and materials over which the contractor has no control. The components subjected to price adjustment will be set out in table of adjustment data included in the bidding document and submitted as a part of bid. Bidders will provide coefficient for an adjustable portion for payment in local currency. For payment in foreign currency, bidders will also provide a fixed portion as well as coefficient and indexes for an adjustable portion in their bids.

In civil works contract, costs of materials such as reinforced steel, bitumen, cement, labor and fuel are significant and subjected to prevailing market condition, and hence they are commonly included in the adjustable portion of contract. Many of these are indirect cost and will not appear as items in the bill of quantities, such as labor and fuel. Each of these costs will be given a coefficient or weight in the price adjustable formula, calculated based on its estimated portion out of total cost estimate. Bidders are generally best placed to determine the weight for each cost element in the work, since the weight of each cost element has the bidder's visibility of the respective input costs, while the borrower doesn't. The choice of construction methods will significantly affect the fixed and adjustable portion of the price adjustment formula[6].

3. Methodology

The major study area of research is to study how provision of price adjustment affect bid price in Road Construction contract and to compare the different formulas of price adjustment being used in Nepalese Road Contracts. The research consists of both primary and secondary data. Diagnostic survey is carried out among 10 contracting firms working under ADB funded projects (SRCP and EEAP projects). It consists of bid prices submitted by ten contracting firms in both cases (When price adjustment clause is applicable and when price adjustment clause is not applicable in contract) for a sample project having project duration 3 years. Similarly, secondary data consists of ADB funded projects, World bank funded projects, Midhill highway projects and Road Improvement projects under Department of Road whose construction work started after 2014, having project duration longer than 2 years and in which price adjustment clause is applicable. Among those projects, project with physical progress more than 80

% is only considered for study.

Project	No of projects with project duration greater than 2 years and in which price adjustment clause is applicable	No of projects having 80% physical progress	Type of formula used
ADB funded	SRCP-7 no EEAP- 6 no	5	Fidic harmonized- 2 no MDB harmonized- 3 no
World Bank funded	Narayanghat Mugling road- 3no	3	Fidic harmonized- 3
Nepal Government funded	Midhill east section- 47 no Midhill west section- 36 no	9	PPMO- 9 no
Exim Bank India	Road Improvement project- 13 no	5	MDB harmonized- 5

Table 3: Projects which are considered for study

4. Analysis Result and Discussion

The bid price submitted by contracting firms when price adjustment clause according to FIDIC Harmonized is applicable and not applicable was compared. The increase in bid price in overall contract when price adjustment clause is not applicable is shown in table below-

SN	Name of Contractor	Percentage increase
1	CTCE Kalika JV	3.68%
2	Taijan Raman Kankai JV	7.32%
3	Lumbini Kankai Surya JV	6.41%
4	Lama Nagarjun JV	4.88%
5	Lama Nagarjun Trishuli JV	6.93%
6	Bajra Guru Amar JV	6.35%
7	Swachhhanda Diwa JV	3.85%
8	CR5-Swachhhanda JV	5.60%
9	Lama Construction co. ltd	4.39%
10	Nepal Adarsha Tamang JV	4.54%
	Average Percentage	5.395%

Table 4: Percentage increase in overall bid price when price adjustment clause in not applicable in contract.

Result shows that contracting firm Taijjan Raman Kankai JV has loaded highest risk premium 7.32% and CTCE Kalika JV has loaded lowest risk premium 3.68% when price adjustment clause is not applicable in a contract. All ten contracting firms has increased their bid price in a range of 3% to 8%. The average percentage increase in bid price among 10 contractors is found to be 5.395%. The average increase in bid price on different items of Road contract among 10 contracting firms is shown in table below.

SN	Name of Contractor	Average %
1	General item	0
2	Site Clearance	4.5%
3	Earth work	4.171%
4	Retaining and Breast wall	3.089%
5	Cross drainage and side drainage work and Miscellaneous work	4.532%
6	Pavement work	8.02%
7	Road furniture and Traffic safety measures	6.8%
8	Day work	9.034%

Table 5: Percentage increase in bid price of certain item when price adjustment clause is not applicable in contract.

Result shows that Contractor's doesn't add risk premium in general items and maximum premium is added on items like Day work (9.034%), Pavement work (8.032%), Road Safety and Traffic measures (6.08%). The ratio of price adjustment to cost estimate of project and ratio of price adjustment to total payment amount for different project having project progress more than 80% are given below

Contract no	Project	Percentage of price adjustment amount to estimated amount	Percentage of price adjustment amount to payment amount	Project Duration
SRCP/ICB/EWH-1	ADB	3.08%	3.27%	3 years
SRCP/ICB/LB-1	ADB	2.74%	4.5%	3 years
NIR-TTP-DOR-W-ICB-1	World Bank	1.53%	1.979%	3 years
NIR-TTP-DOR-W-ICB-2	World Bank	0.92%	1.011%	3 years
NIR-TTP-DOR-W-ICB-3	World Bank	1.98%	2.369%	3 years

Table 6: Contracts using FIDIC Harmonized formula (large Contract) for price adjustment.

In a contracts using FIDIC Harmonized formula (large contract) for price adjustment Construction inputs are break down into labor, fuel and materials and materials are further break down into cement, bitumen etc. Results shows that percentage of price adjustment to estimated amount is always less than percentage of price adjustment to total payment amount of contract. It is because contract amount is always lower than estimated amount. Similarly, it is found that, ratio of price adjustment amount to total payment amount in FIDIC Harmonized formula is in range from 1% to 5%.

Contract no	Project	Percentage of price adjustment amount to estimated amount	Percentage of price adjustment amount to payment amount	Project Duration
337138/070/071-202	Midhill East	3.91%	7.831%	2 years
337138/072/073-103	Midhill East	3.09%	6.586%	2 years
3371384/072/073-106	Midhill East	3.12%	6.78%	2 years
3371384/072/073-001	Midhill East	2.63%	5.612%	2 years
3371384/070/071-203	Midhill East	4.20%	8.46%	2 years
2072-73/003	Midhill West	4.29%	8.6%	3 years
2072-73/001	Midhill West	4.66%	7.21%	3 years
2073-74/007	Midhill West	4.74%	9.698%	2 years
2073-74/006	Midhill West	4.5%	8.46%	2 years

Table 7: Contracts using PPMO (NCB) formula for price adjustment.

In a contracts using PPMO (NCB) formula for price adjustment Construction inputs are break down into labor, fuel and materials. Results shows that percentage of price adjustment to estimated amount is always less than percentage of price adjustment to total payment amount of contract. It is because contract amount is always lower than estimated amount. Similarly, it is found that, ratio of price adjustment amount to total payment amount in FIDIC Harmonized formula is in range from 5% to 10%.

Contract no	Project	Percentage of price adjustment amount to estimated amount	Percentage of price adjustment amount to payment amount	Project Duration
SRCP/NCB/HD-1	ADB	6.50%	12.38%	3 years
SRCP/NCB/HD-3	ADB	5.43%	11.56%	3 years
SRCP/NCB/MR-1	ABD	12.49%	15.7%	3 years
RIP/337133/BD-08/2071-072	RIP	6.76%	11.94%	3 years
RIP/337133/SM-02/2070-071	RIP	9.033%	12.41%	3 years
RIP/3371334/SM-04/2070-071	RIP	12.79%	14.67%	3 years
RIP/337133/BRM-10/2070-071	RIP	11.97%	16.2%	3 years
RIP/337133/BPT/05/2070-071	RIP	11.21%	19.73%	3 years

Table 8: Contracts using MDB formula for price adjustment.

In a contracts using MDB formula (small contract) for price adjustment there is no breakdown of construction inputs and adjustment is directly done for adjustable portion. Results shows that percentage of price adjustment to estimated amount is always less than percentage of price adjustment to total payment amount of contract. It is because contract amount is always lower than estimated amount. Similarly, it is found that, ratio of price adjustment amount to total payment amount in MDB Harmonized formula (small contract) is in range from 10% to 20%.

5. Conclusions

The conclusion drawn are listed below.

1. Contractor add risk premium in bid price if price adjustment clause is not applicable in contract.

2. Bid price goes higher if price adjustment clause is not provided in Construction contract. In average it is found that bid price goes higher by 5.4%.

3. Contractors don't add risk premium in general items and maximum premium is added on items like Day work, Pavement work, Road safety and Traffic measures.

4. Ratio of price adjustment amount to estimated amount is always lower than ratio of price adjustment amount to total payment amount of project.

5. In case FIDIC Harmonized formula (large contract) is used, percentage of price adjustment amount to total payment amount is in range from 1% to 5%.

6. In case PPMO (NCB) contract formula is used, percentage of price adjustment amount total payment amount is in range from 5% to 10%.

7. In case MDB Harmonized formula (small contract) is used, percentage of price adjustment amount to total payment amount is in range from 10% to 20%.

8. Price adjustment contingency 10% of estimated amount specified by PPMO is more than sufficient if FIDIC Harmonized formula (large contract) is used for price adjustment. Similarly, it is sufficient for PPMO (NCB) formula but it is insufficient if MDB Harmonized formula (small contract) is used for price adjustment.

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