4.1 Effect of Price Fluctuations on Civil Engineering Projects

Table 3 lists the effects of price fluctuations on civil engineering projects implemented in Sri Lanka as identified from the literature and agreement of respondents on these issues. All the interviewees agreed with Mishra and Regmi (2017), Mossa (2013), and Nwuba (2004) that poor-quality work, cash flow issues, delayed project completion, disputes, instruction changes, claim entitlements, cost escalations, resource shortages, poor estimation process, and project planning challenges are the impacts caused on civil engineering constructions by price fluctuations.

Nwuba (2004) identified project scope changes, unpredictable project costs, long design stages, and project terminations as the impacts of on civil engineering constructions. R6 rejected that price fluctuations make the estimation process poor stating, '*it would be valid if the contract does not allow for price fluctuations when the bidder would keep a high mark-up for the profit to compensate for the price escalation"*. However, R5 stated '*unlike in building projects, in civil engineering projects, price fluctuations would not cause project scope changes and long design stages"*.

Table 3: Effect of Price Fluctuations on Civil Engineering Projects

Effect	Source/s	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
Poor-quality work	(Mishra and Regmi, 2017)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cash flow issues	(Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Delayed project completion	(Mishra and Regmi, 2017)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disputes among parties	(Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Changes made to project scope	(Nwuba, 2004)	✓	✓	✓	✓				✓	✓	
Unpredictable project costs	(Nwuba, 2004)	✓		✓	✓			✓	✓	✓	✓
Changes made to instructions	(Nwuba, 2004)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Long design stages	(Nwuba, 2004)	✓	✓			✓			✓		
Claim entitlements	(Nwuba, 2004)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cost escalations	(Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Resource shortages	(Nwuba, 2004)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disregard of quality during the estimation process	(Nwuba, 2004)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Difficulties experienced in planning the project	(Nwuba, 2004)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Termination of the project	(Nwuba, 2004)	✓	✓	✓					✓	✓	✓

Most of the interviewees agreed that price escalations have a significant impact on the initial contract sum of civil engineering projects because of their complexity and long durations. According to R8, in a civil engineering project, the cost overruns, which are caused mainly by price escalations, could be 30%–40% of the initial contract sum.

4.2 Price Fluctuation Management by the Contractors of Civil Engineering Projects

Table 4 presents the strategies used by contractors to manage price fluctuations in civil engineering projects implemented in Sri Lanka. Three of the strategies (written in bold text) were identified at the interviews and the others during the literature review. The interviewees confirmed that all the causes identified from the literature were applicable to civil engineering projects implemented in Sri Lanka. Most of the interviewees disagreed with R2 that price fluctuations could be minimised by getting the subcontractors or suppliers to supply materials or any other resources for a fixed price during the construction period. R5 stated, '*because civil engineering projects are of long durations, the subcontractors/suppliers find it difficult to supply materials at fixed prices throughout the project*'.

Although the literature is silent about using effective bidding strategies and allowing the contractors to purchase materials, to minimise the impacts of price fluctuations, all the interviewees believed that the two strategies are effective in managing price escalations in civil engineering projects. R2 stated, '*contractors can purchase materials in bulk at the beginning of the project and use high mark-ups for expensive items and low mark-ups for the other items to maintain the tender sum at a competitive level'*. The strategies can vary with the scope and nature of the project according to R2.

Table 4: Strategies for managing Price Escalations

Strategy	Source/s	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
Adding high mark-ups	(De Mel, 2008)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Incorporating price fluctuation clauses in the contract	(Liyanage, 2005), (Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Using locally available materials in the designs	(Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regular monitoring of the costs incurred, throughout the project, using the data collected from previous projects	(Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Using a risk management protocol	(Mossa, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Using effective bidding strategies		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Letting the subcontractors to manage the risks			✓	✓	✓			✓			
Letting the employer to supply materials				✓	✓	✓	✓	✓	✓	✓	✓

However, as most of the interviewees stated, civil engineering contractors prefer contracts that allow for price escalations because of their reluctance to take risks that can adversely affect their profitability. The interviewees also highlighted that in most civil engineering projects, the formula method is preferred to the traditional method even though the formula method does not produce accurate results. The contractors tend to manage the escalation of construction material prices by transferring the risks to their clients.

4.3 Methods of increasing Contractor Profits while using the CIDA Price Fluctuation Formula

All the interviewees agreed that the CIDA formula helps the contractors to recover their losses caused by price escalations. Most of them, however, believed that the formula allows the contractors to increase their profits. Table 5 presents the drawbacks of the CIDA formula identified from the literature. The interviewees could not identify any additional drawbacks.All 10 interviewees agreed that the literature findings are applicable to civil engineering projects.

When price adjustments are calculated based on the assessed valuation, it can have an effect on the inputs that do not contribute to price adjustments. R4 stated, '*even inputs with small percentage value with no contribution to price fluctuation would result in a significant higher value for price adjustments and therefore, the price adjustments should be based on the cost change rather than on the assessed valuation'*. The items in the bill of quantities that do not require price adjustments will not boost the contractor profit margin. According to most of the interviewees, the contractor puts weights on inputs that are most likely to inflate in the future. Moreover, when a uniform distribution of input percentages is assumed disregarding the inputs that are not used during the given assessment period, causes the contractor profit to increase. R3 emphasised the importance of having norms because allowing the contractor to calculate the input percentages directly is a critical issue in civil engineering constructions.

Agreeing with the literature review findings, R4 stated, '*PIs are location-dependent and that when a PI common to all areas of the country is used in the calculations, the calculated price fluctuations might not be accurate*'. Agreeing to this, R4, R7, and R10 stated that price variations that are dependent on project location, discounts received for the bulk purchase of materials, the use of depreciated tools and equipment, and the use of stocks from other projects might have an impact on the PIs stated in the CIDA monthly bulletin.

R2 suggested that bidding strategies, such as quoting high rates for the expensive items and low rates for the other items and bulk purchase of materials at the early stages of the project would increase contractor profit. R4 stated '*most of the high-profile contractors in Sri Lanka practise the bidding strategies and that they know how the construction material prices would fluctuate'*. Although R5 believed that the increase in the profits earned by contractors are not due to the drawbacks of the CIDA formula, where purchasing mass quantities of materials in the formula so that the contractors may not benefit from increased payments.

As highlighted by most of the interviewees, the price escalation percentage is higher in civil engineering projects than in building projects because of the bulk purchase of

materials. R8 stated, '*in Sri Lanka, the average of the price escalation percentage in civil engineering projects is more than 15%'*. It is mainly due to the material price inflation in the market where the contractor takes its benefit by early material purchase and high input percentages.

4.4 Suggestions to increase the Accuracy of the CIDA Formula

According to the interviewees who were consultants, the contractor should be compensated only for the additional cost incurred due to price escalation without allowing for any profit. Table 6 presents the suggestions that can be implemented to address the drawbacks of the CIDA formula while minimising the additional profits that would be earned by the contractor. It include three suggestions made by the interviewees. In the table, the suggestions made by the interviewees are given in bold text. '*materials such as tar and asphalt should be included in the CIDA bulletin because they are frequently used in road construction projects*'. All the interviewees agreed that the heavy machinery should be categorised in the bulletin and assigned separate indexes.

The profit and overhead factor (K) for the contractor is taken as 15% in the formula. However, different contractors use different overhead and profit ratios. The ratios used by one particular contractor also can vary from project to project. All of the interviewees agreed that the contractors do not follow any particular standard to calculate their overhead and profit margins. R5 stated, 'the contractors can be required to use the CIDA grading system for construction companies to calculate K while keeping in mind the financial challenges faced by the contractors'. Further, the interviewee highlighted that the contractor grading system of CIDA has 11 categories, with C9 being the lowest grade and CS2 the highest grade

Table 5: Drawbacks of the CIDA Formula

Drawbacks	Source	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
Assumption that the input percentages are uniformly distributed	(Mel, 2013)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Calculation of the price adjustments based on the assessed valuation	(Jayasinghe *et al.,* 2015),	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Unavailability of norms for use in input percentage calculations	(Jayasinghe *et al.,* 2015), (De Mel, 2008)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Use of the same PI in all projects irrespective of project location	(Jayasinghe *et al.,* 2015)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Use of the same CAF and RAF for all types of projects	(Jayasinghe *et al.,* 2015)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Assumption that the major cost amounts to 90 % of the project value	(De Mel, 2008), (Jayasinghe *et al.,* 2015)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Assumption that the major cost is recovered when the work items have been completed up to 40 %	(CIDA, 2008), (Jayasinghe *et al.,* 2015)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

According to R1, in the absence of any other accepted formula, consultants are compelled to recommend the CIDA formula method to calculate price fluctuations although the contractors can exploit the drawbacks of the formula to increase their profits. The interviewees, therefore, believed that a competitive bidding process that does not require the use of the CIDA formula was acceptable as it would allow the contractor to bid while allowing for price escalations. The CIDA formula can be revised to address its drawbacks and as R6 stated, '*training programmes could be conducted for industry personnel to make them understand the CIDA formula to ensure its correct application*', which will improve the construction practices.

5. Discussion

The relevance of the study was determined by comparing the literature review findings with the interview findings. The outcome of the interviews was consistent with the literature review findings.

Shou *et al*. (2006) identified that the financial failures of contractors due to inflation and price fluctuations was a critical risk associated with construction projects implemented in developing countries. Gavin (2008) identified inflation as the leading cause of price fluctuations. The interview findings of this study also revealed that inflation was the main reason for price fluctuations in civil engineering projects. Civil engineering construction uses materials and labour extensively, and thus inflation can be categorised as material and labour inflation. Inefficient transportation systems, cultural impacts, and natural disasters were identified at the interviews as causing price fluctuations in civil engineering projects.

Table 6: Suggestions to increase the accuracy of the price fluctuations calculated using the CIDA formula

Suggestion	Source	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
Changing the PI given in the bulletin based on project location	(Samarakoon and Wijewardena, 2021)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Proposing different CAF values according to CIDA grading of the contractors	(Samarakoon and Wijewardena, 2021)			✓	✓	✓	✓	✓	✓	✓	✓
Changing the input percentage values once in 3 months	(Hajjath and Rathnayake, 2019)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Considering the time factor when applying the input percentages			✓	✓	✓	✓	✓	✓	✓	✓	✓
Using an updated HSR	(Hajjath and Rathnayake, 2019)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Using different indexes for the heavy machinery used depending on their category	(Hajjath and Rathnayake, 2019)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Making available the CIDA bulletin on time	(Hajjath and Rathnayake, 2019)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Considering the bulk purchase of materials in the calculation					✓	✓	✓	✓	✓	✓	✓
Using an acceptable method to calculate cost changes		✓	✓	✓	✓	✓	✓	✓	✓	✓	

Although the price fluctuations calculated using the CIDA formula may not be accurate (Ramus, 1982; Suraweera, 2001), De Mel (2008) stated that the contracts that do not allow the recovery of price fluctuations will pose risks to both the contractors and employers. The employer will suffer from poor-quality work while the contractor may face cash flow issues, compromise the standards, lead him to delay project completion, and adopt unethical practices. The experts who were interviewed confirmed that price fluctuations could pose the risks identified from the literature in civil engineering projects as well. Irrespective of whether the contract allows the recovery or non-recovery of price fluctuations, the contractor will attempt to transfer the risks to a third party. According to Liyanage (2005), De Mel (2008), and Mossa (2013), adding high mark-ups, including price fluctuation clauses in the contracts, and using locally available materials in the designs are some of the strategies used by the contractors to address price fluctuations. The early purchase of materials for later use, letting the suppliers to provide materials at a fixed price, and letting the employer to supply materials are the strategies identified at the interviews to address price fluctuations.

Hajjath and Rathnayake (2019) emphasised the benefits of using the CIDA formula in construction contracts because of its ease of use, user-friendliness, and applicability for any contract type, and the benefits it provides for both the client and contractor. However, Jayasinghe *et al.* (2015), Mel (2013), De Mel (2008), and CIDA (2008) found that the uniform distribution of input percentages, calculation of price adjustments based on the assessed valuation, non-availability of a standard for input percentage calculation, disregard of the location when calculating PI, use of the same CAF and RAF for every type of project, and the assumption that the major cost amounts to 90 % of the project value and that it can be recovered when the work items have been completed up to 40 % are the drawbacks of the CIDA formula that provide additional profits to the contractors. The interviewees agreed with the literature review findings and did not want to indicate any additional drawbacks of the formula.

Samarakoon and Wijewardena (2021) and Hajjath and Rathnayake (2019) recommended using PIs and CAF values based on project location and CIDA grading of contractors, respectively; making changes to input percentage values once in 3 months; and using separate indexes for heavy machinery depending on their types to increase the accuracy of the calculations done using the CIDA formula in building projects. The interviewees confirmed the applicability of the recommendations to civil engineering projects and proposed to consider the time factor when applying each input percentage and the bulk purchase of materials in the calculations, and the use of an acceptable method for calculating cost changes in civil engineering projects.

The active participation of the key parties in construction projects will be important for industry expansion (Noruwa, 2020). Because some civil engineering projects for infrastructure developments span in wide geographic areas, project coordination is a complex task. In such situations, excellent communication among team members and a database prepared using information collected from previous projects will help fast decision making and prevent the contractors seeking for undue profits. The contracting parties have to be conversant with the consequences of using the CIDA

formula and manage the excessive profit margins of the contractors.

6. Conclusions and Recommendations

The study findings revealed that the parameters used in the CIDA formula and the assumptions on which the formula was based, caused inaccurate price fluctuations increasing the profits earned by a contractor. The critical drawbacks of the CIDA formula are due to the coefficient factor constant 0.966 used in the formula, assumptions that input percentages were distributed uniformly and that materials were purchased in bulk, the non-use of norms to calculate the input percentages, the disregard of the effect of assessed valuations, and the use of PIs that were common to all districts of the country. The suggestions on the changes required in the formula were made by considering the identified drawbacks. The study also reveal that by estimating K values using the CIDA grading system for construction companies, developing district-level indexes, using an acceptable method for calculating the cost changes within the given valuation period, changing the input percentage values once in three months, considering the time factor when applying each input percentage, using different indexes for different categories of heavy machinery, considering the bulk purchase of materials in the calculations, using an updated HSR, and making available the CIDA bulletin on time , the drawbacks of the CIDA formula can be addressed.

Furthermore, the suggestions made by interviewees, such as establishing a robust communication network among project team members and providing training to industry practitioners on the use of CIDA price fluctuation formula are essential for contractual parties to avoid the misinterpretation of the CIDA formula and alter the formula to suit a particular type of project. The contractors would benefit, if the CIDA price fluctuation formula could be used to calculate price escalation payments in civil engineering projects. Hence, to have a reliable and efficient method for calculating price fluctuations, the CIDA formula can be revised considering the suggestions made in the study. The data used in the formula should be updated regularly for the accuracy in final calculation.

The practical implications of the study are that the study findings will help industry practitioners to manage effectively the price fluctuation claims in civil engineering projects using the CIDA formula and the risk of price escalations. To avoid overestimated price fluctuations, the Sri Lankan government must focus on changing the CIDA formula, or the project teams can take steps to change the formula by changing the parameters. The study findings will help contracting parties to identify potential reasons for increased profits earned by the contractor so that suitable procedures can be implemented to avoid or minimise the overestimation of price fluctuations using the CIDA formula.

Unlike previous studies, this study investigated the causes and made suggestions for managing the contractor profit in civil engineering constructions using the CIDA formula, filling a gap in the literature. This study was limited in that it investigated only the price fluctuations using the CIDA formula in Sri Lanka, commonly considering both small and large-scale contractors. Hence, this can be extended in future to investigate on the effects of the CIDA formula on the profits separately to small and large-scale contractors.

7. References

Antwi, S. K., and Hamza, K. (2015). Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business and Management, 7*(3), 217-225.

Asian Development Bank (ADB). (2018). *Price adjustment guidance note on procurement*. ADB publications. Availabe at https://www.adb.org/sites/default/files/procurement-price-adjustment.pdf

Ashworth, A. (1991). *Contractual procedures in the construction industry* (2nd ed.). New York: Longman.

Azhar, N., Farooqui, R.U., and Ahmed, S.M. (2008). Cost overrun factors in construction industry of Pakistan. *The First International Conference on Construction in Developing Countries (ICCIDC-I)*, (pp. 499-508). Available at https://www.academia.edu/download/50235837/051.pdf.

Brewster, A.L., Curry, L.A., Cherlin, E.J., Talbert-Slagle, K., Horwitz, L.I. and Bradley, E.H. (2015), Integrating new practices: a qualitative study of how hospital innovations become routine, *Implementation Science*, *10*(1), 168.

Bryman, A. and Bell, E. (2015), *Business Research Methods*, Oxford University Press, Oxford.

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D. and Walker, K. (2020). Purposive sampling: complex or simple? Research case examples. *Journal of Research in Nursing*, *25*(8), pp.652-661. https://10.1177/1744987120927206

Central Bank of Sri Lanka (CBSL). (2011). *Annual Report*. Available at https://www.cbsl.gov.lk/en/publications/economic-and-financial-reports/annual-reports/annual-report-2011

Central Bank of Sri Lanka (CBSL). (2013). *Annual report*. Available at https://www.cbsl.gov.lk/en/publications/economic-and-financial-reports/annual-reports/annual-report-2013

Central Bank of Sri Lanka (CBSL). (2020). *Annual report*. Available at https://www.cbsl.gov.lk/en/publications/economic-and-financial-reports/annual-reports/annual-report-2020

Chan, A. P., Yung, E. H., Lam, P. T., Tam, C. M., and Cheung, S. O. (2000). Application of Delphi method in selection of procurement systems for construction projects. *Construction Management and Economics*, *19*(1), 699–718. https://10.1080/01446190110066128

Construction Industry Council (CIC). (2011). *Guidelines on contract price fluctuation System*. Hong Kong. Available at https://www.cic.hk/cic_data/pdf/about_cic/publications/eng/V10_6_e_V00_20111219.pdf

Construction Industry Development Authority (CIDA). (2008). *CIDA formula method for adjustments to contract price due to fluctuation in prices*. (2nd ed). Colombo: CIDA.

Creswell, J. W. (2013). *Research design*. (4th ed). California: SAGE.

Creswell, J.W. and Plano Clark, V.L., 2011. Choosing a mixed methods design. *Designing and conducting mixed methods research*, *2*, pp.53-106.

De Mel, J. (2008). *Basic Concepts and Derivation of CIDA Formula and Introduction of CIDA Formula. CIDA price fluctuation formula*. Colombo: Institute for Construction Training and Development.

Du Toit, J. L., and Mouton, J. (2013). A typology of designs for social research in the built environment. *International Journal of Social Research Methodology, 16*(2), 125–139. https://10.1080/13645579.2012.657013

Gavin, W. (2008). *Financial crisis and the construction industry. Contractor's survival guide*. Akerman Senterfitt. Available at https://documents.akerman.com/contractorssurvivalseminar.pdf

Gentles, S. J., Charles, C., Ploeg, J., and McKibbon, K. (2015). Sampling in qualitative research: Insights from an overview of the methods literature. *Qualitative Report*, *20*(11), (1772–1789). Available at https://nsuworks.nova.edu/tqr/vol20/iss11/5

Government Procurement Policy Board (GPPB). (2008). *Revised guideline for contract price escalation*. Available at https://www.gppb.gov.ph/issuances/Guidelines/Price%20Escalation.pdf

Hajjah, A.K.M. and Rathnayake, M.D. (2019). Appropriateness of CIDA price fluctuation formula for road construction in Sri Lanka. In: Sandanayake, Y.G., Gunatilake, S. and Waidyasekara, A. (eds). *Proceedings of the 8th World Construction Symposium*, (107-115). https://doi.org/10.31705/WCS.2019.11

Hanna, A.S. and Blair, A.N. (1993). A rational method for the treatment of escalation in construction costs. *Organisation and Management of Construction the Way Forward*, *1*(3), (1415-1425).

Ho, S.P. and Liu, L.Y. (2004). Analytical model for analysing construction claims and opportunistic bidding. *Journal of Construction Engineering and Management*. *130* (1), (94–104). https://doi.org/10.1061/(ASCE)0733-9364(2004)130:1(94)

Hossain, D. M. (2011). Qualitative research approach. In *Postmodern Openings*. 7, (143–156). Available from: Available at http://postmodernopenings.com/wp-content/uploads/2011/10/Qualitative-Research-Process.pdf

Jayalath, C. (2013). *Arguing construction claims: Basis, eligibility, quantum, limitations, hypothesis, defences*. Colombo: S Godage and Brothers Pvt Ltd.

Jayasinghe, S. A. Y. B. S., Alahakoon, C. S., and Wijewardena, L. S. S. (2015). Sensitivity of the CIDA price fluctuation formula procedure for the true material price fluctuations in the construction industry. *Journal of Engineering and Technology of the Open University of Sri Lanka (JET-OUSL. 3*(1), (19-40). Available at http://repository.ou.ac.lk/bitstream/handle/94ousl/974/JET-OUSL-Vol3-No1-Paper%202.pdf?sequence=1

Jayaweera, S.C., Perera, B.A.K.S., and Jayasinghe, S.J.A.R.S. (2015). Applicability of CIDA price fluctuation formula for government-funded intelligent building projects. *The 4th World Construction Symposium*, (99-108). Available at https://www.researchgate.net/publication/317328750

Kaare, K. K. and Koppel, O. (2012). Improving the road construction supply chain by developing a national level performance measuring system. *International Journal of Social and Human Sciences*, *6*(2), (225-231). https://10.1.1.308.5192&rep=rep1&type=pdf

Kangari, R. (1988). Business failure in construction industry. *Journal of Construction Engineering and Management*, *114*(2), (172-90). https://10.1108/eb021137

Kvale, S. (1996), *Interviews: An Introduction to Qualitative Research Interviewing*, Sage Publications, Thousand Oaks, CA.

Lioudis, N.K. (2018). *What causes oil prices to fluctuate?*. Available at https://www.investopedia.com/ask/answers/012715/what-causes-oil-prices-fluctuate.asp

Liyanage, B. (2005). *Examination of Price Fluctuation Reimbursement by Simplified CIDA Formula* (Unpublished B.Sc. Dissertation). Department of Building Economics, University of Moratuwa, Sri Lanka.

Lune, H., and Berg, B.L. (2016). *Qualitative Research Methods for the Social Sciences*. Hudson, NY: Pearson.

Mason, J. (2004). Semi-structured interview. Lewis-Beck, M.S., Bryman, A.E. and Liao, T.F.F. (Eds), The Sage Encyclopaedia of Social Science Research Methods, Sage Publications, Thousand Oaks, CA.

McCartney, M. (2011). Pakistan growth, dependency and crisis. *The Lahore Journal of Economics*,*16*(1), (71-94). Available at https://lahoreschoolofeconomics.edu.pk/EconomicsJournal/Journals/Volume%2016/Issue%20SP/04%20McCartney%20Pakistan,%20Growth,%20Dependency.pdf.

Mel, J.D. (2013), *Basic concepts and logical approach of CIDA formula*, Colombo, CIDA.

Mishra, A.K. and Regmi, U., 2017. Effects of price fluctuation on the financial capacity of "Class A" contractors. *International Journal of Creative Research Thoughts*, *5*(4), (1920-1937).

Mossa, M. G. (2013). *Assessment of price escalation and adjustment problems on federal road construction projects*. (1st ed). Ethopia: s.n.

Nagi, S.C. (2002). A theoretical framework for determining the minimum number of bidders in construction bidding competitions. *Journal of Construction Management and Economics*, *20* (6), (473–482). doi:10.1080/01446190210151041

National Procurement Agency. (2006). *Procurement guideline 2006: Good and works*. Colombo: Department of Government Printing. Available at https://www.treasury.gov.lk/documents/procurement/ProcurementGuidelines2006_amded12June.pdf

Noruwa, B.I., Arewa, A.O., and Merschbrock, C. (2020). Effects of emerging technologies in minimising variations in construction projects in the UK. *International Journal of Construction Management,* (1-8). https://doi.org/10.1080/15623599.2020.1772530

Nwuba, C. (2004). An analysis of housing construction costs trends in Nigeria. *Quantity Surveyor*, *47*, (4-9).

Peiris, R.D.G. (1993). *Price fluctuation reimbursement* (Unpublished B.Sc. Dissertation). University of Moratuwa, Sri Lanka.

Rooke, J. (2004). Planning for claims: an ethnography of industry culture. *Journal of Construction Management and Economics*, *22* (6), (655–662). https://10.1080/0144619042000263 24

Ramus, J. (1982). *Contract practice for Quantity surveyors*. London: Biddles Ltd.

Sally, R. (2006). Sri Lanka: the economic failure. *The conference on globalisation and economic success: Policy Options for Africa*, (1-16). Available at https://ecipe.org/wp-content/uploads/2014/12/Sally.srilanka.pdf

Samarakoon, A. S. and Wijewardena, L. S. S. (2021). Impact of contractor's overhead and profit factor on price fluctuation calculated using CIDA price fluctuation formula. *the 10th International Conference on Structural Engineering and Construction Management (ICSECM*, (59-68). Available at https://link.springer.com/chapter/10.1007/978-981-15-7222-7_6

Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students*, 5th ed. England: Pearson Education Limited.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., and Jinks, C., B. (2018). Saturation in qualitative research: Exploring its conceptualisation and operationalisation, *Quality and Quantity*, *52* (4), (1893-1907). Available at https://link.springer.com/article/10.1007/s11135-017-0574-8

Sendooran, B. (2005). *Impact of oil price increases in construction industry* (Unpublished B.Sc. Dissertation). University of Moratuwa, Sri Lanka.

Shou, Y., Ma, Z., Lu, T., and Sorrentino, B. P. (2006). Unique risk factors for insertional mutagenesis in a mouse model of XSCID gene therapy. *Proceedings of the National Academy of Sciences*, *103*(31), (11730-11735). https://doi.org/10.1073/pnas.0603635103

Silva, L. (2011). Forecasting of Cost Escalations in Post Disaster Construction with Tsunami Reconstruction in Sri Lanka. *Built-Environment Sri Lanka*, (56-63). Available at https://pdfs.semanticscholar.org/0e53/a6eb20085ed14a54283fcfe83c20890a613a.pdf.

Singh, A. S., and Masuku, M.B. (2014). Sampling Techniques and Determination of Sample Size in Applied Statistics Research: An Overview. *International Journal of Economics, Commerce and Management*, *2*(11), (1–22). Available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.678.1300&rep=rep1&type=pdf.

Subasinghe, S.A.S.K. (2009). *Appropriateness of CIDA price fluctuation formula for road projects* (Unpublished B.Sc. Dissertation). University of Moratuwa, Sri Lanka.

Suraweera, E.H. (2001). *Inflation and dealing with price fluctuation* (Unpublished B.Sc. Dissertation). Department of Building Economics, University of Moratuwa, Sri Lanka.

World Bank. (2016). *10 years of better roads in Sri Lanka*. Available at https://www.worldbank.org/en/news/feature/2016/05/05/10-years-of-better-roads-in-sri-lanka

Tan, Y. (2008). An examination of the factors affecting contractor's competition strategy: a Hong Kong study. *International Journal of Project Organization and Management*. *1* (1), (4–23). https://10.1504/IJPOM.2008.020026