

Impact of Material and Labour Cost Overruns on Contractors' Budgeted Cost: The Case of Building Construction Projects in Sri Lanka

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Abstract

Contractors' budgeted cost overrun is treated as a regular feature in construction projects. It was evident that the major impact for the contractors' budgeted cost overrun has happened with the material cost and labour cost. Hence, the paper aims to find common causes for the material and labour cost overruns as well as strategies to reduce the impact on the contractors' budgeted cost overrun. A comprehensive literature review along with the expert interviews under the qualitative research approach was adopted during the data collection. Subsequently, frequency analysis was adopted to analyse data collected through interviews. The study identified 10 and 12 common causes for material and labour cost overruns respectively which can influence the contractors' budgeted cost overrun. Further, 7 common strategies were identified to minimise the material and labour cost overruns under each category. As the next step, future research should aim to provide statistical methods to inspect and analyse the impact level of significant cost variables on the contractors' budget.

Keywords

Budgeted Cost Overrun, Causes, Labour, Material, Strategies

1. Introduction

The construction industry plays a crucial role in the development of the economic growth of any country and it has been attested that the construction industry has turned out to be one of the leading industries inside the globe (Vaardini et al. 2016). Project completion within the budget can be regarded as one of the major forces for the successful performance of a project (Memon et al. 2010). Traditionally, the main stakeholders in a project such as the contractor and the client have more influence on the cost performance of any project (Deshmukh and Menkudle 2019). Accordingly, a predetermined accurate budget is essential for stakeholders of construction projects (Lim et al. 2016). Dakhli and Lafhaj (2019) stated that there is a considerable difference between contractors' budgeted cost and the actual cost at completion in many construction projects. Therefore, without controlling primary cost influencing factors, contractors will not be able to control their expenditures effectively (Cheng, 2014). On the other hand, this issue causes to increase in overall project costs and affect contractors' profit.

However, if the contractors can identify and be familiar with causes for cost overrun by their perspectives, it will help to reduce the impact on the contractors' profit (Mitra and Shrestha 2017). Furthermore, researchers have found several factors that affect the construction cost and investigated the ways to minimise the cost overruns. According to Olatunji et al. (2018), there is a strong relationship between material price increments and cost overruns in construction projects. Further, when there are changes in material cost and labour cost probably there may be cost overruns in construction projects (Dominic and Smith 2014). In addition, Burke (as cited in Albtoush et al. 2020) stated that the cost of construction material and labour should control and manage well.

Hence, this paper aims to find the common causes for material and labour cost overruns on the contractors and suggestions to minimise the impact from those causes. Accordingly, the paper is structured as follows. First, the literature review is presented on critical variables impact on construction cost. Then justification of research method. Finally, the results of the study with an outline of the implication for construction contractors.

2. Literature Review

As highlighted by previous researches, cost overrun is a major obstacle faced by the construction industry and it interferes with industry development (Ilyas et al. 2020). However, if the contractors can identify and be familiar with causes for cost overrun by their perspectives, it will help to reduce the impact on the contractors' profit (Mitra and Shrestha 2017).

Anyhow, it is important to give the maximum contribution of all stakeholders on completing construction projects within the predefined budget while minimising the variations (Rahsid et al. 2013; Bakr 2014). At the end, one or more parties have to bear the financial loss due to construction cost overrun beyond the bound of possibilities (Rahman et al. 2019).

2.1 Variables Impact on Construction Cost

Cost variables and their impact on the construction cost can differ from project to project based on the size, type, and location of the projects (Andrić et al. 2019). Simultaneously, Samarghandi et al. (2016) professed that delays due to defects of the client, contractor, and consultant can be created an unbearable impact on the construction cost. Lowe et al. (2006) mentioned that construction cost shall influence by project strategic, design and site-related variables. Olawale and Sun (2010) stated, price fluctuation, inaccurate estimates, delays, and additional work as the main variables that affect construction cost overruns (p. 509). Inaccurate budgeting and resource planning also have a high weight comparing to other variables related to cost overruns (Susanti 2020). Many variables can be found, which affect construction costs throughout the construction process (Olawale and Sun 2015). Consequently, there is an essential need to inspect variables affecting cost overrun to avoid a bad impact on construction costs (Stoy et al. 2008).

2.2 Critical Cost Variables Relate to the Contractors' Budget

As stated by Rashid (2020), previous researchers have presented several variables that affect construction cost overruns in general. Even though there are categorisations of common factors, it is important to separately identify the significant cost variables for specific projects in specific countries (Susanti 2020). Many researchers have identified the main causes of contractors' cost overrun through different investigations and presented relevant approaches (Lu et al. 2017). These main causes, which affect cost overruns are important to all stakeholders such as contractors, to predict the risk of future projects and to prepare precise estimates and plans (Andrić et al. 2019). Aljohani et al. (2017) revealed that price fluctuations of material and weak material management on site are predominant variables for contractors' budgeted cost overruns. 50 critical cost variables that affect contractors' budget were identified from 10 previous research studies.

More than half of the selected 10 research studies indicated 'unreasonable estimation and modifications of project costs', 'inadequate contractor experience' and 'increase in material price' as critical variables. Moreover, it is noted that many variables are related to labour. Hence, this paper has selected main variables as material and labour.

2.3 Impact of Material and Labour Cost on Contractors' Budget

Ullah (2020) has investigated that, even small cost change in factors such as labour-related cost variables or construction material cost-related variables can highly influence the cost overrun or time overrun in construction projects. Supporting the above statement, Ashaari et al. (2019) have found that variables such as material related issues and labour related issues are affecting contractors' budget heavily. Joukar (2016) mentioned that the price volatility of material and labour is a prominent cause of contractors' budgeted cost overruns. Further, if there are delays in the material supply chain, it probably affects the overall project performance because the construction activities get delayed due to the unavailability of material at the site at that moment (Wang and Hubbard 2017). According to Rashid (2020), there are many causes related to labour costs such as less labour productivity, shortage of labour and conflict of personal opinion among labours and those can aggravate not only contractors' budgeted cost overrun but also the construction time overrun.

According to Choi et al. (2018), the construction industry in the United State also awfully suffering from the labour shortage. A study conducted by Hwang et al. (2013) within Singapore revealed that labour availability on site is one of the top three causes for project delays and can lead to failure of contractors' cost performance. Avoidance of cost overrun assists to minimise delays, disputes and abandoned construction projects (Sambasivan et al. 2017). Therefore, keeping construction costs within the estimated boundary requires sound strategies, good practices, and careful

judgments (Memon et al. 2014). However, there are only a few researches have been done to address the significant issues, how to tackle those and the responsibilities of stakeholders related to construction cost overruns (Doloi 2013). In the Sri Lankan context, no research has been done to find the practical causes for material cost and labour cost overrun which can influence the contractors' budgeted cost overrun in building construction projects. Hence, this research addresses the issue of "Causes for material and labour cost overruns, which can influence the contractors' budgeted cost overruns in Sri Lankan construction industry" and gives "Strategies to minimise the particular impacts" based on the contractors' view.

3. Research Methodology

According to Pandey and Pandey (2015), "interview is a two-way method which permits an exchange of ideas and information" (p. 59). To achieve the study aim, 12 semi-structured interviews were conducted with open-ended questions to collect contractor specific causes. According to Guthrie et al. (2004), content analysis is one of the most common analysis methods that can apply in investigating the frequency of responses. Hence, "Frequency" was the measure used to find causes for material and labour cost through the responses of interviewees. Moreover, the frequency (F) of the responses was calculated using Equation 1, to select the common causes for material and labour cost overrun.

$$\text{Frequency (F)} = \frac{\text{Number of Responses for the Cause}}{\text{Number of Respondents}} \times 100 \% \quad (1)$$

4. Data Collection

For the data collection, twelve experts from six-building construction projects were interviewed. All six projects were selected from the organisations which are well-known construction companies in Sri Lanka with CS-2, which is the highest grading for building works as given by the Construction Industry Development Authority (CIDA) in Sri Lanka. Three projects were government-funded projects and the rest three projects were funded by private sector organisations. Further, the selected projects have been faced with contractors' budgeted cost overrun due to several variables. The profile of respondents is summarised in Table 1.

Table 1: Profile of respondents

Contractor Organisation	Respondent Code (RC)	Designation	Industry Experience (Years)		
			5-10	10-15	Above 15
A	AR 1	Quantity Surveyor			√
	AR 2	Quantity Surveyor	√		
B	BR 1	Quantity Surveyor			√
	BR 2	Quantity Surveyor	√		
C	CR 1	Quantity Surveyor			√
	CR 2	Quantity Surveyor	√		
D	DR 1	Quantity Surveyor			√
	DR 2	Quantity Surveyor		√	
E	ER 1	Quantity Surveyor			√
	ER 2	Civil Engineer			√
F	FR 1	Civil Engineer			√
	FR 2	Civil Engineer		√	

5. Results and Discussion

5.1 The Impact on Contractors' Budgeted Cost Due to Major Cost Variables

It was questioned about the opinion of the impact on contractors' budgeted cost from material cost and labour cost for building construction projects. Except one respondent, all the others answer was that the cost of material is about 60% to 70% of the total cost overrun and labour cost can be 20%-30% of the total cost overrun.

AR1 stated, “we should consider about the preliminary cost (Indirect cost) overruns also and this opinion may depend on the type of material”. AR2 mentioned, “the impact may depend on the project features”. CR1 and CR2 said, “the influence on the contractors’ budgeted cost overrun from material cost and labour cost is high in building construction projects comparing to the infrastructure projects”.

As mentioned by DR2 “effect of material cost and labour cost for contractors’ budgeted cost overrun depends on the project features as well as the weight given over project cost to the relevant costs”. BR1 answered differently, “it is unlikely to happen overrun in material cost because there is less chance to underutilise or over utilise with regards to quantities in the bidding stage. The only way that material cost can go wrong is due to the pricing of the material. According to BR2, “experienced contractors can minimise this material and labour cost overrun easily, other than unexpected costs due to unexpected situation”. The DR1 contended, “it cannot say material and labour costs are the causes for every budget overruns. There are direct costs and indirect costs which relate to project cost. Most of the time overrun may happen due to the underestimation in indirect cost also. If there is no or smaller overrun due to indirect cost underestimation, the rest of the overrun may happen due to material, labour, and machinery cost issues”. However, every respondent was agreed that material cost and labour cost can influence the contractors’ budget liberally. Further, ER2 elaborated, “the contractors are trying to budget three ‘M’s (Man, Material, Machinery) with accurate norms. If the contractor failed to budget these three Ms accurately most probably there could be an overrun in labour (man), material, and machinery costs. That will surely affect the contractors’ budget negatively”. Therefore, if there is a material cost or labour cost overrun, the contractor can expect an overrun in the initial budget often.

5.2 Causes for Material Cost Overrun

The respondents were asked to mention the variables that affect material cost overruns for building construction projects. The variables identified as the causes for material cost overrun which can affect contractors’ budgeted cost overrun could be summarised into 31 causes based on the answers of the respondents and presented in Table 2.

Table 2: Causes for material cost overrun

ID	Cause (Material Cost Related)	ID	Cause (Material Cost Related)
M1	Scarcity of resources.	M2	Restrictions due to force major situations.
M3	Material destructions due to force major situations (COVID 19).	M4	Government policy changes.
M5	Price fluctuation of materials (If the contract is not allowing).	M6	Improper planning.
M7	High wastage of material.	M8	Misplace of material due to irresponsibility of labours.
M9	Stealing materials.	M10	Improper material handling.
M11	Suppliers are not complying with the material delivery schedule.	M12	Bad material storing.
M13	Over ordering.	M14	Material supply delays.
M15	Import and manufacturing restrictions.	M16	Material quality issues.
M17	Inflation.	M18	Errors of the procurement process.
M19	Unavailability of proper specifications.	M20	Inadequate records at the moment of ordering.
M21	Rework.	M22	Poor supervision.
M23	Poor workmanship.	M24	Not allowing price fluctuation for material by the client.

ID	Cause (Material Cost Related)	ID	Cause (Material Cost Related)
M25	Inappropriate material waste control strategies.	M26	Improper utilisation.
M27	Unexpected weather conditions	M28	Incorrect norms.
M29	Improper site management.	M30	Government restrictions.
M31	Estimation errors.		

The causes which have equal or more than 25% frequency (i.e highlighted by more than two respondents) were selected as the common causes for material cost overrun as per contractors view and summarised in Table 3. Each respondent has mentioned five to ten causes. 'Material price fluctuation' and 'high wastage of material' were the most common variables highlighted by many respondents, which were having 58% of frequency that can affect the material cost overrun.

Table 3: Common causes for material cost overruns

ID	Respondent Code												F %
	AR1	AR2	BR1	BR2	CR1	CR2	DR1	DR2	ER1	ER2	FR1	FR2	
M5	√	√			√			√	√	√		√	58
M7		√			√	√		√	√		√	√	58
M16				√	√	√	√	√					42
M21					√	√				√	√	√	42
M6	√	√		√		√							33
M10		√	√					√	√				33
M12			√						√			√	25
M14			√				√				√		25
M22						√	√					√	25
M28									√	√		√	25

5.3 Causes for Labour Cost Overrun

Similarly, the respondents were asked to mention variables that affect labour cost overruns in building construction projects. The variables related to labour cost overrun which can affect contractors' budgeted cost overrun could be summarised into 30 variables based on the answers of the respondents and presented in Table 4.

Table 4: Causes for labour cost overrun

ID	Causes (Labour Cost Related)	ID	Causes (Labour Cost Related)
L1	Less productivity of labours.	L2	Labour rate increment.
L3	Labour idling.	L4	Desert the work by labours.
L5	Incompatibility between budgeted rates and the actual rate.	L6	Mismatch of labour skills (Eg: Deploy skilled labour where unskilled labour needed).
L7	Paying allowance for labour overtime.	L8	Use labours unnecessarily for several works.
L9	Additional cost for additional labour facilities.	L10	Less labour availability.
L11	Fewer skills levels of labours.	L12	Errors in labour gang.
L13	Additional work time due to errors in the method statement.	L14	The high demand for labour suppliers.
L15	The inefficiency of labours.	L16	Improper monitoring.
L17	Fewer work sequences.	L18	Additional works due to errors.
L19	Less smart workings.	L20	Poor supervision.
L21	Time extension of the project.	L22	Adverse weather conditions.

ID	Causes (Labour Cost Related)	ID	Causes (Labour Cost Related)
L23	Inadequate skilled labours.	L24	Improper management.
L25	Reworks.	L26	Inappropriate behaviour of the workers.
L27	Issues due to irresponsible labours.	L28	Labour abstinence due to several issues.
L29	Improper Planning.	L30	Additional labour requests for payments.

A similar frequency analysis was done for the causes for labour cost overrun which can affect contractors' budgeted cost overruns and results are summarised in Table 5.

According to AR2, BR2, DR2, and FR1, many labours are requesting additional facilities more than supposed to provide by the contractor. If these facilities could not provide labours will desert the jobs. Therefore, to retain the labours, the contractors, have to spend more than the budgeted amount for labour facilities.

The study revealed that the cost for the additional labour facilities (L9) is high, and it can be a cause for labour cost overruns in many building constructions projects.

Table 5: Common causes for labour cost overruns

ID	Respondent Code												F %
	AR1	AR2	BR1	BR2	CR1	CR2	DR1	DR2	ER1	ER2	FR1	FR2	
L3	√		√	√				√	√	√		√	58
L1	√		√						√	√	√	√	50
L10		√		√			√		√	√			42
L11		√		√	√		√		√				42
L9		√		√				√			√		33
L23						√		√			√	√	33
L2	√	√	√										25
L4	√								√		√		25
L5	√		√									√	25
L7		√					√			√			25
L12			√			√		√					25
L20						√	√			√			25

5.4 Appropriate Strategies to Reduce Contractors' Budget Overrun

During the interviews, the respondents were asked to suggest strategies to reduce contractors' budgeted cost overrun through reducing material cost, labour cost, and project cost overruns as the final question. Each respondent has mentioned several strategies and the findings of the study are summarised under the following subsections.

5.4.1 Strategies to Reduce Material Cost Overrun

Strategies to reduce the impact of material cost overrun on the contractors' budget can be summarised into 35 variables based on the responses and presented in Table 6.

Table 6: Strategies to minimise the impact of material cost overrun on contractors' budgeted cost overrun

ID	Strategies (Material Cost Related)	ID	Strategies (Material Cost Related)
SM1	Try to purchase bulk material quantities.	SM2	Maintain proper relationship with suppliers.
SM3	Compliant for a fixed rate for major cost items with the suppliers.	SM4	Prepare accurate estimation.
SM5	Use alternative materials with equivalent quality.	SM6	Proper supervision.

ID	Strategies (Material Cost Related)	ID	Strategies (Material Cost Related)
SM7	Ensure the site safety to reduce thefts.	SM8	Provide proper instructions to labours regarding material handling.
SM9	Adhere to the correct methods of storing material.	SM10	Deal with a reliable set of suppliers.
SM11	Maintain and update a vendor list.	SM12	Order precision.
SM13	Make the delivery as one constraint while purchasing.	SM14	Adhere to the guidelines supplies by the manufactures to avoid damages and to the given special precautions.
SM15	Use a third-party inspection agency to check material quality.	SM16	Proper procurement programming.
SM17	Proper planning in the initial stage.	SM18	Take time to estimate.
SM19	Order material based on shop drawings.	SM20	Proper record keeping.
SM21	Use wastage control strategies.	SM22	Ensure the material quality.
SM23	Strictly adhere to the specifications and designs.	SM24	Proper site management.
SM25	Optimum utilisation.	SM26	Calculate the theoretical requirement of the quantity of material.
SM27	Consider market conditions before planning to purchase.	SM28	Proper material management.
SM29	Work according to orders.	SM30	Preparing rates through work studies.
SM31	Subcontracting labours along with materials.	SM32	Good housekeeping.
SM33	Adhere to the 5S concept properly.	SM34	Work according to the project programme.
SM35	Use skilled labours to reduce wastage.		

Similar to the frequency analysis done previously, strategies that were suggested by more than two respondents to minimise the impact of material cost overrun on the contractors' budgeted cost overruns were highlighted in Table 6. Accordingly, purchasing bulk material quantities (SM1) was mentioned by five respondents, whereas 'provide proper instructions to labours regarding material handling (SM8)' and 'use wastage control strategies (SM21)' were suggested by four respondents.

5.4.2 Strategies to Reduce Labour Cost Overrun

The strategies to reduce the impact of labour cost overrun on the contractors' budget could be summarised into 30 variables and presented in Table 7.

Common strategies mentioned by more than two respondents to minimise the impact of labour cost overrun on contractors' budgeted cost overruns are highlighted in Table 7.

Ensure adequate labour supervision (58%) is the recommended best way to reduce unnecessary labour cost overrun by the respondents. Work according to the master programme (SL3) is one of the special strategies mentioned by some respondents not only to reduce labour cost overrun but also to reduce the time overrun of any project. Moreover, respondents recommended the labour subcontracting method than the direct labour deployment (SL15) as an effective way to reduce labour costs.

Table 7: Strategies to minimise the impact of labour cost overrun on contractors' budgeted cost overrun

ID	Strategies (Labour Cost Related)	ID	Strategies (Labour Cost Related)
SL1	Work with labour suppliers than direct labours.	SL2	Compliant for a fixed rate with labour suppliers.
SL3	Work according to the master programme.	SL4	Ensure adequate labour supervision.
SL5	Proper planning of manpower	SL6	Improve estimation skills.
SL7	Get site-level feedbacks from the site supervisors frequently.	SL8	Maintain inhouse labour force for accurate norms.
SL9	Maintain pre-agreed labour rates.	SL10	Minimise the idling.
SL11	Deploy the labours with pertinent skills for suitable activities.	SL12	Give the necessary training to labours.
SL13	Proper managing decisions	SL14	Managing labour suppliers properly.
SL15	Labour subcontracting is better than direct labours.	SL16	Frequent monitoring of daily labour work.
SL17	Find, categorise labours based on their actual skills and pay according to that.	SL18	Give labour targets.
SL19	Provide adequate facilities.	SL20	Conduct motivation programmes.
SL21	Use skilled supervisors.	SL22	Find skilled labours.
SL23	Give incentives to labours and improve work sequence.	SL24	Reduce unnecessary overtime.
SL25	Proper site supervision and management.	SL26	Correct norms usage.
SL27	Eliminate the nonproductive workers.	SL28	Reduce unnecessary labour staff.
SL29	Proper synergy among designers' supervisors and labours.	SL30	Use proper safety procedures.

5.4.3 Strategies to Reduce Project Cost Overrun

In addition to strategies to minimise materials and labour cost overruns, the respondents were asked to suggest strategies to reduce the impact of project cost overrun on the contractors' budget and results are presented in Table 8.

Table 8: Strategies to minimise the impact of project cost overrun on contractors' budgeted cost overrun

ID	Strategies (Project Cost Related)	ID	Strategies (Project Cost Related)
SP1	Work along with the master programme.	SP2	Proper management of staff.
SP3	Try to reduce the indirect cost overrun in the project.	SP4	Proper estimation for indirect costs.
SP5	Reduce the unnecessary cost of the staff.	SP6	Adhere to the method statement.
SP7	Use resource histograms.	SP8	Resource levelling.
SP9	Optimise the resource utilisation.	SP10	Use best fit equipment for work
SP11	Proper and frequent cost monitoring.	SP12	Practice EV management system.
SP13	Proper planning and management.	SP14	Take time to estimate.
SP15	Use mutual agreements with the client is necessary.	SP16	Use experienced and skilled staff.
SP17	Proper resource management.	SP18	Proper supervision of every activity.

ID	Strategies (Project Cost Related)	ID	Strategies (Project Cost Related)
SP19	Proper record keeping.	SP20	Focus on the professional development of staff.
SP21	Planning for future risks.	SP22	Keep proper synergy among designers and contractor.
SP23	Keep proper synergy among the engineer and contractor.	SP24	Adhere to the site rules.
SP25	Management should have sound knowledge about the project.	SP26	Ensure and adhere to proper site safety procedures.
SP27	Good communication with the client	SP28	Advice to the staff regarding their responsibilities frequently.
SP29	Proper coordination between the site and the site office.	SP30	Ensure the quality of the works.
SP31	Address the foreign material price fluctuation.	SP32	Accurate estimation for work items.
SP33	Maintain a smaller number of works in progress (WIP).	SP34	Use proper communication methods.
SP35	Predict the weather conditions.		

Similarly, frequency analysis results can present (suggested by more than two respondents) to identify common strategies to minimise the contractors' budgeted cost and highlighted in Table 8.

Most respondents recommended minimising project cost overrun by working strictly adhering to the project programme. According to the respondents, if the project is facing delays due to any reason, the cost of the project will increase. Then, probably there will be a budget overrun to the contractors.

As previously mentioned, if there is a contractors' budgeted cost overrun, the project cost overrun may be there or not, but if there is a project cost overrun, probably contractors' cost overrun may occur. Therefore, the contractor should pay attention on strategies to reduce material and labour cost overruns as well as strategies to reduce project cost overrun to minimise contractors' budgeted cost overruns.

6. Conclusions and Recommendations

Even though there are many cost variables related to construction cost, the material and labour costs can ensure as critical cost variables that can influence the contractors' budgeted cost overrun heavily.

Price fluctuation of materials, high wastage of material, material quality issues, rework, improper planning, improper material handling, bad material storing, material supply delays, poor supervision, and incorrect norms are common material related causes for contractors' budgeted cost overruns in building construction projects.

As well as labour idling, less labour availability, less skills levels of labours, desert the work by labours, errors in labour gang, poor supervision, additional cost for additional labour facilities, incompatibility between budgeted rates and the actual rate, paying allowance for labour overtime, less productivity of labours, inadequate skilled labours and labour rate increment are common labour related causes for contractors' budgeted cost overrun in building construction projects.

Purchase bulk material quantities, provide proper instructions to labours regarding material handling, use wastage control strategies, prepare accurate estimation, proper supervision, adhere to the correct methods of storing material and maintain a vendor list were identified as common strategies to reduce the impact of material cost overrun. Further, ensure adequate labour supervision, work according to the master programme, labour subcontracting is better than direct labours, proper planning of manpower to the works, minimise the idling, provide adequate facilities and conduct motivation programmes can recommend as common strategies to reduce labour cost overruns in building construction projects.

Additionally, work along with the master programme, proper and frequent cost monitoring, proper planning and management, reduce the unnecessary cost of the staff, use experienced and skilled staff and planning for future risks were suggested to reduce project cost overruns in building projects. The study revealed that cost monitoring and record keeping are important in building construction projects, which are not practising properly in many construction sites.

The strategies as well as common causes related to materials and labour identified through this study will minimise impact to the contractors' budgeted overruns and ensure the contractor financial stability.

References

- Akinradewo, O., Aigbavboa, C., and Akinradewo, O., Revisiting causative factors of project cost overrun in building construction projects in Nigeria. *IOP Conference Series: Materials Science and Engineering*, vol. 640, no. 1, pp. 1–6. Available: <https://doi.org/10.1088/1757-899X/640/1/012002>, 2019.
- Albtoush, A. M. F., Doh, S. I., Rahman, A. R. B. A., and Albtoush, J. A. A., Factors effecting the cost management in construction projects. *International Journal of Civil Engineering and Technology (IJCIET)*, vol. 11, no. 1, pp. 105–111. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3534623/issues.asp?JType=IJCIET&VType=11&IType=1, 2020.
- Aljohani, A., Ahiaga-Dagbui, D., and Moore, D., Construction projects cost overrun: What does the literature tell us? *International Journal of Innovation, Management and Technology*, vol. 8, no. 2, pp. 137–143. Available: <https://doi.org/10.18178/ijimt.2017.8.2.717>, 2017.
- Amusan, L. M., Afolabi, A., Ojelabi, R., Omuh, I., and Okagbue, H. I., Data exploration on factors that influences construction cost and time performance on construction project sites. *Data in Brief*, vol. 17, pp. 1320–1325. Available: <https://doi.org/10.1016/j.dib.2018.02.035>, 2018.
- Andrić, J. M., Mahamadu, A. M., Wang, J., Zou, P. X. W., and Zhong, R., The cost performance and causes of overruns in infrastructure development projects in Asia. *Journal of Civil Engineering and Management*, vol. 25, no. 3, pp. 203–214. Available: <https://doi.org/10.3846/jcem.2019.8646>, 2019.
- Ashaari, N. I. M., Amir, M., Hashim, S., and Huey, Y. S., Cost overrun in construction projects in Malaysia : A study on contractor related factors. *INTI Journal*, vol. 52, pp. 1–5. Available: http://eprints.intimal.edu.my/1326/1/vol.2019_052.pdf, 2019.
- Bakr, G. A., Studying the status of variations in construction contracts in Jordan. *Computing in Civil and Engineering, April*, pp. 187–194. Available: <https://doi.org/10.1061/9780784413616.024>, 2014.
- Cheng, Y. M., An exploration into cost-influencing factors on construction projects. *International Journal of Project Management*, vol. 32, no. 5, pp. 850–860. Available: <https://doi.org/10.1016/j.ijproman.2013.10.003>, 2014.
- Choi, J. O., Shrestha, P. P., Lim, J., and Shrestha, B. K., An investigation of construction workforce inequalities and biases in the Architecture, Engineering, and Construction (AEC) industry. *Construction Research Congress 2018*, vol. 2012, pp. 725–735. Available: <https://ascelibrary.org/doi/10.1061/9780784481301.007>, 2018.
- Cindrela Devi, A., and Ananthanarayanan, K., Factors influencing cost overrun in Indian construction projects. *MATEC Web of Conferences*, vol. 120, pp. 1–8. Available: <https://doi.org/10.1051/mateconf/201712002023>, 2017.
- Dakhli, Z., and Lafhaj, Z., Cost evolution throughout the construction value chain. *Modular and Offsite Construction (MOC)*, pp. 33–40. Available: <https://doi.org/10.29173/mocs74>, 2019.
- Deshmukh, S. S., and Menkudle, S. D., Case study on “ budget and schedule overrun during the construction phase of project.” *International Research Journal of Engineering and Technology (IRJET)*, vol. 6, no. 4, pp. 353–356. Available: https://www.academia.edu/39583124/IRJET-Case_Study_on_Budget_and_Schedule_Overrun_during_the_Construction_phase_of_Project_, 2019.
- Doloi, H., Cost overruns and failure in project management: Understanding the roles of key stakeholders in construction projects. *Journal of Construction Engineering and Management*, vol. 139, pp. 267–279. Available: [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0000621](https://doi.org/10.1061/(ASCE)CO.1943-7862.0000621), 2013.
- Dominic, A. D. D., and Smith, S. D., Rethinking construction cost overruns: Cognition, learning and estimation. *Journal of Financial Management of Property and Construction*, vol. 19, no. 1, pp. 38–54. Available: <https://doi.org/10.1108/JFMPC-06-2013-0027>, 2014.
- Gómez-Cabrera, A., Ponz-Tienda, J. L., Pellicer, E., and Sanz, A., Factors generating schedule delays and cost overruns in construction projects. *XI Simpósio Brasileiro De Gestão E Economia Da Construção VIII Encontro Latinoamericano De Gestão Y Economía De La Construcción, October*. Available: <https://www.researchgate.net/publication/336889237>, 2019.
- Guthrie, J., Petty, R., Yongvanich, K., and Ricceri, F., Using content analysis as a research method to inquire into intellectual capital reporting. *Journal of Intellectual Capital*, vol. 5, no. 2, pp. 282–293. Available: <https://doi.org/10.1108/14691930410533704>, 2004.
- Hiroshan, S. A. C., and Hadiwattege, C., Factors Affecting Construction Cost in Sri Lanaka. *CIOB-S7023CRP*, pp. 238–243. Available: <https://www.researchgate.net/publication/326893355>, 2014.

- Hwang, B. G., Zhao, X., and Ng, S. Y., Identifying the critical factors affecting schedule performance of public housing projects. *Habitat International*, vol. 38, pp. 214–221. Available: <https://doi.org/10.1016/j.habitatint.2012.06.008>, 2013.
- Ilyas, M., Li, J., and Ullah, I., Study of factors causing time and cost overrun in pre-construction project (A case study of Malaysia). *World Journal of Engineering and Technology*, vol. 8, no. 1, pp. 1–12. Available: <https://doi.org/10.4236/wjet.2020.81001>, 2020.
- Iqbal, A., Rehman, H. S. U., Munir, M., Ashiq, M., Omar, A., Haider, Z., Akhtar, M., Javed, M., Rehman, O. U., Adnan, M., and Jahanzaib, M., Time and cost overrun in construction projects of Pakistan. *Pakistan Journal of Engineering and Technology, PakJET*, vol. 2, no. 2, pp. 22–29. Available: <https://sites2.uol.edu.pk/journals/index.php/pakjet/article/view/84>, 2019.
- Joukar, A., *Analysis and management of the price volatility in the construction industry*. Available: https://digitalcommons.lsu.edu/gradschool_dissertations/182%0AThis, 2016
- Lee, J., Cost overrun and cause in Korean social overhead capital projects : Roads , rails , airports , and ports. *Journal of Urban Planning and Development*, vol. 2, no. 59, pp. 59–62. Available: [https://doi.org/10.1061/\(ASCE\)0733-9488\(2008\)134:2\(59\)](https://doi.org/10.1061/(ASCE)0733-9488(2008)134:2(59)), 2008.
- Lim, B., Nepal, M. P., Skitmore, M., and Xiong, B., Drivers of the accuracy of developers' early stage cost estimates in residential construction. *Journal of Financial Management of Property and Construction*, vol. 21, no. 1, pp. 4–20. Available: <http://dx.doi.org/10.1108/JFMPC-01-2015-0002>, 2016.
- Lowe, D. J., Emsley, M. W., and Harding, A., Relationships between total construction cost and project strategic, site related and building definition variable. *Journal of Financial Management of Property and Construction*, vol. 11, no. 3, pp. 165–180. Available: <https://doi.org/10.1108/13664380680001087>, 2006.
- Lu, W., Hua, Y. Y., and Zhang, S. J., Logistic regression analysis for factors influencing cost performance of design-bid-build and design-build projects. *Engineering, Construction and Architectural Management*, vol. 24, no. 1, pp. 118–132. Available: <https://doi.org/10.1108/ECAM-07-2015-0119>, 2017.
- Memon, A. H., Rahman, I. A., Abdullah, M. R., and Azis, A. A. A., Factors affecting construction cost performance in project management projects: Case of MARA large projects. *International Journal of Civil Engineering and Built Environment*, vol. 1, no. 1, pp. 30–35. Available: <https://www.researchgate.net/publication/266897131>, 2014.
- Mitra, J. P., and Shrestha, K. J., Analysis of construction cost variation of onstruction Manager General Contractor (CM / GC) project. *55th ASC Annual International Conference, February 2016*, pp. 491–497. Available: <http://www.ascpro.ascweb.org>, 2017.
- Olatunji, O. A., Orundami, A. O., and Ogundare, O., Causal relationship between material price fluctuation and project's outturn costs. *Built Environment Project and Asset Management*, vol. 8, no. 4, pp. 358–371. Available: <https://doi.org/10.1108/BEPAM-12-2017-0119>, 2018.
- Olawale, Y. A., and Sun, M., Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. *Construction Management and Economics*, vol. 28, no. 5, pp. 509–526. Available: <https://doi.org/10.1080/01446191003674519>, 2010.
- Olawale, Y., and Sun, M., Construction project control in the UK: Current practice, existing problems and recommendations for future improvement. *International Journal of Project Management*, vol. 33, no. 3, pp. 623–637. Available: <https://doi.org/10.1016/j.ijproman.2014.10.003>, 2015.
- Pandey, P., and Pandey, M. M., *Research methodology : Tools and techniques* (1st ed.). Bridge Center. Available: <http://www.euacademic.org/BookUpload/9.pdf>, 2015.
- Rahman, I. A., Foo, L. C., Memon, A. H., and Nagapan, S., Schedule and cost behaviour in construction works of Malaysia. *Pakistan Journal of Science*, vol. 71, no. 4, pp. 74–77. Available: <https://search.proquest.com/openview/f6a97b76fcc2f32f81abdf43eb05ec7b/1?pq-origsite=gscholar&cbl=1616340>, 2019.
- Rahsid, Y., Haq, S. ul, and Aslam, M. S., Effects of delay in construction projects of Punjab-Pakistan : An empirical study. *Journal of Basic and Applied Scientific Research.*, vol. 3, no. 10, pp. 87–96. Available: <https://www.semanticscholar.org/paper/Effects-of-Delay-in-construction-Projects-of-An-Rahsid-Aslam/2d7b38dce89a37c6907c4161f5b17c5492a8a4d0>, 2013.
- Rashid, Y., Analysis of delay factors and their effects on construction projects. *Management Science Letters*, vol. 10, no. 6, pp. 1197–1204. Available: <https://doi.org/10.5267/j.msl.2019.11.039>, 2020.
- Samarghandi, H., Tabatabaei, S. M. M., Taabayan, P., Hashemi, A. M., and Willoughby, K., Studying the reasons for delay and cost overrun in construction projects : The case of Iran. *Journal of Construction in Developing Countries*, vol. 21, no. 1, pp. 51–84. Available: <https://doi.org/10.21315/jcdc2016.21.1.4>, 2016.
- Sambasivan, M., Deepak, T. J., Salim, A. N., and Ponniah, V. Analysis of delays in Tanzanian construction industry.

- Engineering, Construction and Architectural Management*, vol. 24, no. 2, pp. 308–325. Available: <https://doi.org/10.1108/ECAM-09-2015-0145>, 2017.
- Sohu, S., Abdullah, A. H., Nagapan, S., Rind, T. A., and Jhatial, A. A., Controlling measures for cost overrun causes in highway projects of Sindh province. *Engineering, Technology & Applied Science Research*, vol. 9, no. 3, pp. 4276–4280. Available: <https://www.researchgate.net/publication/333667959>, 2019.
- Stoy, C., Pollalis, S., and Schalcher, H., Drivers for cost estimating in early design: Case study. *Journal of Construction Engineering and Management*, vol. 134, no. 1, pp. 32–39. Available: [https://doi.org/10.1061/\(ASCE\)0733-9364\(2008\)134:1\(32\)](https://doi.org/10.1061/(ASCE)0733-9364(2008)134:1(32)), 2008.
- Stoy, C., and Schalcher, H. R., Residential building projects: Building cost indicators and drivers. *Journal of Construction Engineering and Management*, vol. 133, no. 2, pp. 139–145. Available: [https://doi.org/10.1061/\(ASCE\)0733-9364\(2007\)133:2\(139\)](https://doi.org/10.1061/(ASCE)0733-9364(2007)133:2(139)), 2007.
- Susanti, R., Cost overrun and time delay of construction project in Indonesia. *Journal of Physics: Conference Series*, vol. 1440, pp. 1–8. Available: <https://doi.org/10.1088/1742-6596/1444/1/012050>, 2020.
- Ullah, I., Assessment of critical factors responsible for cost and time overruns in pre construction planning phase of construction projects. *Civil and Environmental Research*, vol. 11, no. 12, pp. 58–65. Available: <https://doi.org/10.7176/CER/11-12-07>, 2020.
- Vaardini, U. S., Karthiyayini, S., and Ezhilmathi, P., Study on cost overruns in construction projects- A review. *International Journal of Applied Engineering*, vol. 11, pp. 356–363. Available: <https://www.researchgate.net/publication/303459769>, 2016.
- Wang, H., and Hubbard, B., A survey study on industrial construction project supply chain: On time performance and practices of structural steel and pipe spools. *Procedia Engineering*, vol. 196, pp. 653–659. Available: <https://doi.org/10.1016/j.proeng.2017.08.054>, 2017.

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