

INFLUENCE OF INFLATION RATE ON MACHINERY HIRE RATES IN CONSTRUCTION INDUSTRY

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Abstract — Cost overrun is encountered in various construction projects and even with various advancement, the issue remains. When cost overrun occurs in any construction project, it not only affects the project also leaves marks on the construction industry as well. Machinery hire rates are important while finalizing the project budget and when the rates change annually it may result in project cost overrun. Due to these facts, this study investigates the effect of inflation rate on machinery hire rates. Inflation is a powerful influencing factor in deviating the prices and the rates which result in cost overrun. Statistical analysis was performed where the Spearman correlation was used as the data possess a nonlinear behaviour. The overall result came significant as the inflation rate showed a strong relationship with 9 machinery hire rates demonstrating that the inflation rate is the most prominent factor in deviating the rates. Three (3) machinery hire rates showed a moderate relationship, whereas 1 showed a weak relationship with the inflation rate. Therefore, a consideration of the inflation rate should be made in budget estimation.

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Keywords: Labour Productivity, Critical factors, Road, Construction Industry, Pakistan

1.0 INTRODUCTION

The construction industry impacts substantially on the development of society and stabilizing the country's economy [1-4]. It is wide in nature where many other industries are connected to it [5]. Besides providing the necessary infrastructure, the construction industry also offers high employment chances. However, major distress in the construction industry worldwide is a cost overrun which occurred in most of the construction projects. This problem exists in both developing and developed countries as out of ten, nine construction projects face the issue of cost overrun [6-8].

The construction project performance requires further development to fulfil market demand and meet the needs of the stakeholders [9]. Construction projects are dynamic and are considered successful only when completed on the set schedule, within the assigned budget. A project is unsuccessful due to the impact of change in order, delay in work or cost overrun. Even with various advancement in the industry, cost overrun in the construction project could not be eliminated [10-15].

Thus, it is necessary to eliminate the causes which result in cost overrun in the construction projects [16]. In the initial stage of the construction project, cost estimation is important as it relies on the economic conditions at that time. Precise estimation is crucial as there is pressure involved in increasing project cost on the investors and the decision-makers, which also impacts the national finance. In this case, providing the solution to cost overrun is getting essential [17-19].

Changes in the machinery hire rates are least considered while finalizing the project budget which results in cost overrun at the end of the construction project. Many previous researchers stress that the inflation rate is the most influential factor in deviating the rates and thus results in cost overrun [20-26]. The inflation rate influences the anticipated budget by changing the machinery hire rates annually with lead to the cost overrun. The effect of inflation is not restricted to deviating the rates, but it also affects the construction industry performance and the country's economy [27-29]. In both private and public construction projects, a noteworthy connection between the inflation rate and cost overrun exists [30].

Therefore, this study is mainly focusing on the statistical approach by performing correlation analysis on the inflation rate and machinery hire rates and finding out how much influence does the inflation rate has on deviating

the rates annually. The scope of this study was limited to only 14 machinery types as they were the only rates that were available for 7 years.

2.0 METHODOLOGY

Thirty The methodology of this study was carried out by performing statistical analysis through Statistical Package for Social Sciences (SPSS-24) on the collected data of machinery hire rates from the year 2013 to 2019 of the Malaysian construction industry to observe the impact of the inflation rate on machinery hire rates.

2.1. Data Collection

WP Kuala Lumpur machinery hire rates data for fourteen machinery types were collected from CIDB Malaysia [31] as shown in Table 1. Whereas, the inflation rate data was accumulated from the Department of Statistics Malaysia [32] as shown in Table 2.

Table 1 WP Kuala Lumpur Machinery Hire Rates

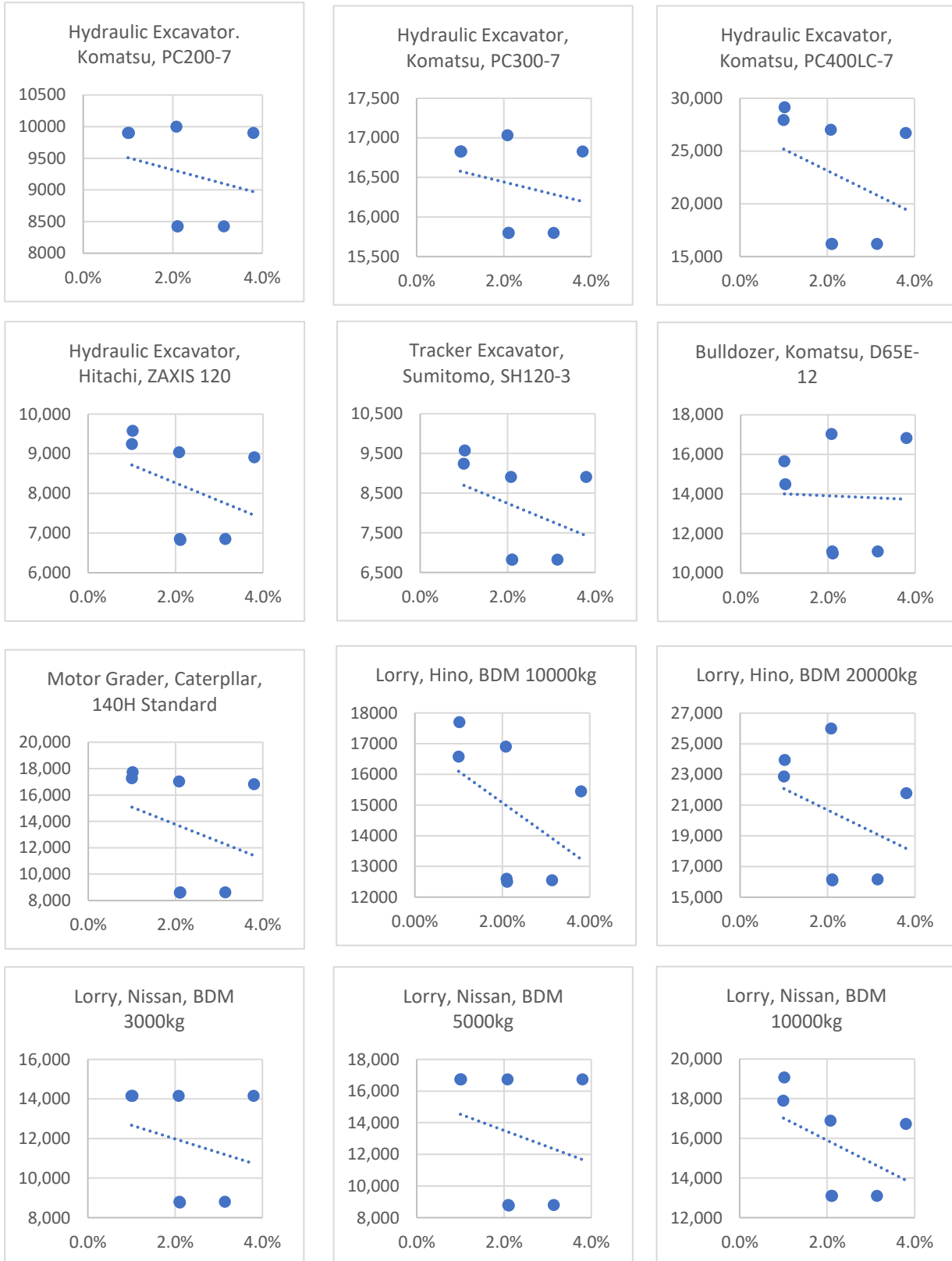
S.No	Type	Symbol	Machinery Hire Rates (RM per month)						
			2013	2014	2015	2016	2017	2018	2019
1	Hydraulic Excavator, Komatsu, PC200-7	E1	8426.67	8,426.67	8,426.67	10000	9900	9900	9900
2	Hydraulic Excavator, Komatsu, PC300-7	E2	15,800	15,800	15,800	17033.33	16830	16830	16830
3	Hydraulic Excavator, Komatsu, PC400LC-7	E3	16,200	16,200	16,200	27033.33	26730	27948.34	29166.67
4	Hydraulic Excavator, Hitachi, ZAXIS 120	E4	6,825	6,850	6,850	9033.33	8910	9243.34	9576.67
5	Tracker Excavator, Sumitomo, SH120-3	E5	6,826.67	6,826.67	6,826.67	8910	8910	9243.34	9576.67
6	Bulldozer, Komatsu, D65E-12	D1	11,000	11,100	11,100	17033.33	16830	15665	14500
7	Motor Grader, Caterpillar, 140H Standard	M1	8,633.33	8,633.34	8,600	17033.33	16830	17281	17733.33
8	Lorry, Hino, BDM 10000kg	L1	12500	12,550	12,600	16900	15444	16573.67	17703.33
9	Lorry, Hino, BDM 20000kg	L2	16,100	16,166.67	16,166.67	26000	21780	22869	23958
10	Lorry, Nissan, BDM 3000kg	L3	8,766.67	8,800	8,800	14157	14157	14157.84	14158.67
11	Lorry, Nissan, BDM 5000kg	L4	8,766.67	8,800	8,800	16731	16731	16731.84	16732.67
12	Lorry, Nissan, BDM 10000kg	L5	13,100	13,100	13,100	16900	16731	17900.5	19070
13	Mobile Crane, Kato, NK200H II	C1	7,850	7,850	7,850	14833.33	14850	13691.67	12533.33
14	Mobile Crane, Kato, NK450B	C2	16,066.67	16,066.67	16,066.67	25740	25740	26286.67	26833.33

Table 2 Inflation Rate, Malaysia

Year	2013	2014	2015	2016	2017	2018	2019
Inflation Rate	2.11%	3.14%	2.10%	2.08%	3.80%	1.00%	1.02%

2.2. Data Analysis

The correlation coefficient is one of the strongest statistical tools to measure the relationship or the impact of one variable on the other. The coefficient value lies from +1 to -1 indicating the positive and the negative strength of the relationship. Correlation test demands on the nature of the data. If the data possess a linear behaviour usually Pearson correlation is performed but if the data possess nonlinear behaviour, then the Spearman correlation is performed [33]. The graphical representation was made to show the nonlinearity of the data as shown in Figure 1.



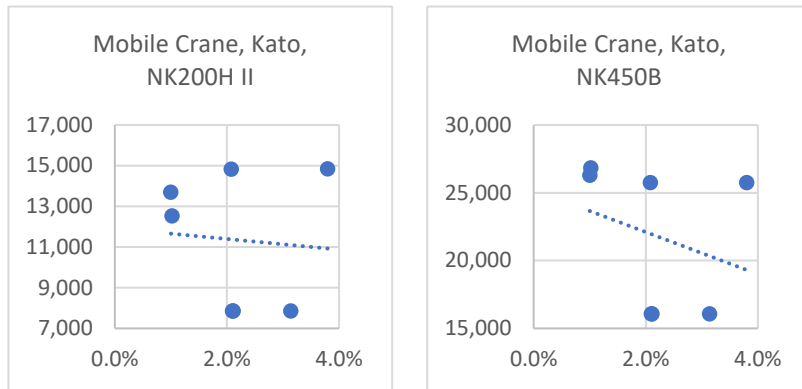


Figure 1 Inflation and Machinery Hire Rates Scatter graphs

On the x-axis the inflation rate was plotted, and, on the y-axis, the machinery hire rate was plotted. A linear trend line was drawn in the graph which shows how far away are the rates from the trend line proving the nature of the data is nonlinear. Due to nonlinearity in data, the Spearman correlation was measured to observe the impact of the inflation rate on the machinery hire rates.

3.0 RESULTS AND DISCUSSION

This section shows the summarized, as well as individual machinery hire rates coefficient value of the Spearman correlation test.

3.1. Spearman Correlation Coefficient

Spearman correlation test was performed on the nonlinear data of machinery hire rates to examine the influence of the inflation rate on changing the machinery hire rates. The summary of the overall correlation coefficient is shown in Figure 2.

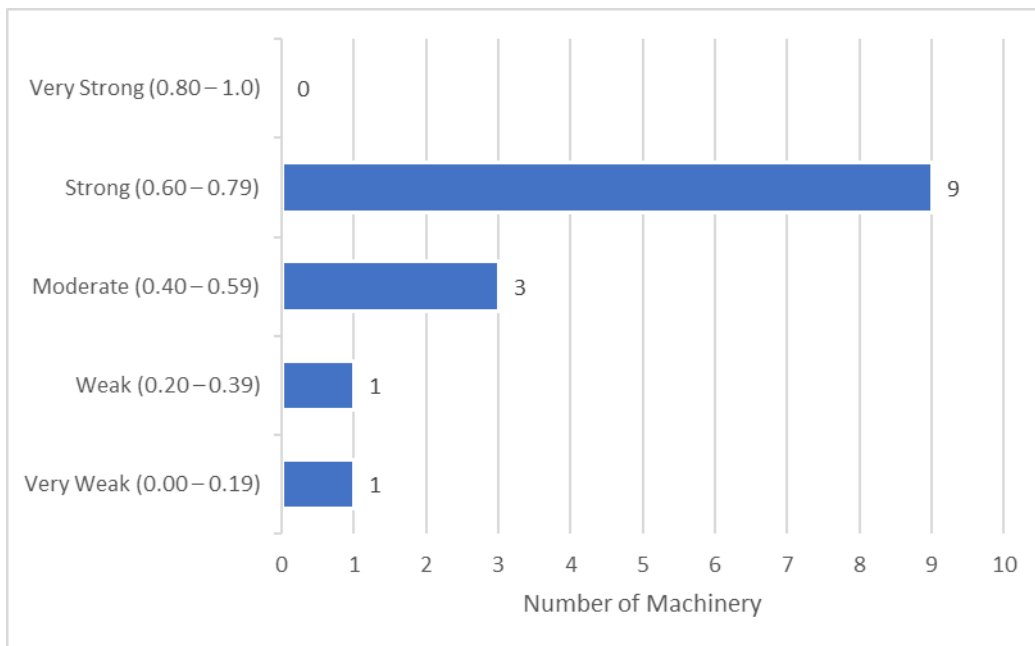


Figure 2 Correlation Coefficient summary of Machinery Hire Rates

Figure 2 shows that most of the machinery hire rates showed a strong relationship with the inflation rate. A very few lies in the scale of a very weak to a moderate relationship. The individual correlation coefficient of machinery hire rates is shown in Table 3.

Table 3 Individual correlation coefficient of Machinery Hire Rates

S. No	Types of Machine	Spearman Correlation Coefficient	Level of correlation
1	E1	-0.424	Moderate
2	E2	-0.424	Moderate
3	E3	-0.704	Strong
4	E4	-0.685	Strong
5	E5	-0.636	Strong
6	D1	-0.216	Weak
7	M1	-0.607	Strong
8	L1	-0.643	Strong
9	L2	-0.577	Moderate
10	L3	-0.618	Strong
11	L4	-0.618	Strong
12	L5	-0.704	Strong
13	C1	-0.074	Very weak
14	C2	-0.636	Strong

Table 3 shows that there is a negative strong relationship between the inflation rate with the machinery hire rates. When two variables move in opposite directions it is a negative relationship or a negative correlation. The highest coefficient value was shown by “Hydraulic Excavator, Komatsu, PC400LC-7” and “Lorry, Nissan, BDM 10000kg” with a value of -0.704. Whereas, the lowest coefficient value was shown by “Mobile Crane, Kato, NK200H II” with a value of -0.074. Nine (9) out of 14 machinery hire rates possess a strong relationship with the inflation rate, proving that if the inflation rate changes, it will affect the machinery hire rates as well. The role of diesel/petrol consumption is also important in this aspect as the maximum usage can deviate the rates. Thus, utmost attention is required to avoid cost overrun which occurred by the fluctuating machinery hire rates annually due to the inflation rate.

3.0 CONCLUSION

Machinery hire rates are incorporated in the cost of the project while estimating the budget. The variations in the rates annually affect the overall budget and thus results in cost overrun. When the phenomena were checked whether the inflation rate is the one that influences the machinery hire rates annually, the results came as strongly significant to the established objective. The inflation rate is making a substantial change in the machinery hire rates as the correlation coefficient result was highly significant and all coefficient value come in the negative scale of a strong relationship. Therefore, it is concluded that in the Malaysian construction industry the inflation rate has a vibrant role in affecting the machinery hire rates and thus should be included while estimating the budget.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

- [1] M. A. Musarat and M. Z. Ahad, "Factors Affecting the Success of Construction Projects in Khyber Pakhtunkhwa, Pakistan," *Journal of Construction Engineering and Project Management*, vol. 6, no. 4, pp. 1-6, 2016.
- [2] M. A. Musarrat, O. Inderyas, S. Khan, and A. A. Shah, "Causes of delay in the execution phase of construction projects in Khyber Pukhtoonkhwa Pakistan," *Sarhad University International Journal of Basic and Applied Sciences*, vol. 4, no. 1, pp. 62-70, 2017.
- [3] B. A. Tayeh, K. Al Hallaq, W. S. Alaloul, and A. R. Kuhail, "Factors affecting the success of construction projects in Gaza Strip," *The Open Civil Engineering Journal*, vol. 12, no. 1, 2018.
- [4] W. S. Alaloul, M. S. Liew, N. A. Wan Zawawi, B. S. Mohammed, and M. Adamu, "An Artificial neural networks (ANN) model for evaluating construction project performance based on coordination factors," *Cogent Engineering*, vol. 5, no. 1, p. 1507657, 2018.
- [5] W. S. Alaloul, M. S. Liew, N. A. W. A. Zawawi, and B. S. Mohammed, "Industry revolution IR 4.0: future opportunities and challenges in construction industry," in *MATEC web of conferences*, 2018, vol. 203, p. 02010: EDP Sciences.
- [6] K. Ullah, A. H. Abdullah, and S. Nagapan, "A framework for avoiding cost overruns in Malaysian construction projects," *International Journal of Advanced and Applied Sciences*, vol. 3, no. 3, pp. 28-31, 2016.
- [7] A. Aljohani, D. Ahiaga-Dagbui, and D. Moore, "Construction projects cost overrun: What does the literature tell us?," *International Journal of Innovation, Management and Technology*, vol. 8, no. 2, p. 137, 2017.
- [8] M. S. Abdullah, W. S. Alaloul, M. S. Liew, and B. S. Mohammed, "Delays and cost overruns causes during construction of palm oil refinery projects," in *MATEC Web of Conferences*, 2018, vol. 203, p. 02004: EDP Sciences.
- [9] W. S. Alaloul, M. S. Liew, and N. A. W. A. Zawawi, "Identification of coordination factors affecting building projects performance," *Alexandria Engineering Journal*, vol. 55, no. 3, pp. 2689-2698, 2016.
- [10] X. Mashwama, C. Aigbavboa, and D. Thwala, "Investigation of construction stakeholders' perception on the effects & cost of construction dispute in Swaziland," *Procedia engineering*, vol. 164, pp. 196-205, 2016.
- [11] A. Firouzi, W. Yang, and C.-Q. Li, "Prediction of total cost of construction project with dependent cost items," *Journal of Construction Engineering and Management*, vol. 142, no. 12, p. 04016072, 2016.
- [12] S. Bayram and S. Al-Jibouri, "Efficacy of estimation methods in forecasting building projects' costs," *Journal of construction engineering and management*, vol. 142, no. 11, p. 05016012, 2016.
- [13] M. Altaf, M. A. Musarat, A. Khan, Z. Shoukat, and U. Salahuddin, "Change Order Impact on Construction Industry of Pakistan," in *AWAM International Conference on Civil Engineering*, 2019, pp. 391-402: Springer.
- [14] W. S. Alaloul, M. A. Musarat, M. Liew, and N. A. W. A. Zawawi, "Influential Safety Performance and Assessment in Construction Projects: A Review," in *AWAM International Conference on Civil Engineering*, 2019, pp. 719-728: Springer.
- [15] W. S. Alaloul, M. Liew, N. A. W. A. Zawawi, and I. B. Kennedy, "Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders," *Ain Shams Engineering Journal*, 2019.
- [16] M. Borse and P. Khare, "Analysis of cost and schedule overrun in construction projects," *International Journal of Innovative Science, Engineering & Technology (IJSET)*,(3), vol. 1, pp. 383-386, 2016.
- [17] H. Abusafiya and S. Suliman, "Causes and effects of cost overrun on construction project in Bahrain: Part I (ranking of cost overrun factors and risk mapping)," *Modern Applied Science*, vol. 11, no. 7, p. 20, 2017.
- [18] W. S. Alaloul, M. A. Musarat, M. Liew, A. H. Qureshi, and A. Maqsoom, "Investigating the impact of inflation on labour wages in Construction Industry of Malaysia," *Ain Shams Engineering Journal*, 2021.
- [19] M. A. Musarat, W. S. Alaloul, M. Liew, A. Maqsoom, and A. H. Qureshi, "The Effect of Inflation Rate on CO2 Emission: A Framework for Malaysian Construction Industry," *Sustainability*, vol. 13, no. 3, p. 1562, 2021.
- [20] H. Alinaitwe, R. Apolot, and D. Tindiwensi, "Investigation into the causes of delays and cost overruns in Uganda's public sector construction projects," *Journal of Construction in Developing Countries*, vol. 18, no. 2, p. 33, 2013.
- [21] L. M. Amusan, A. Afolabi, R. Ojelabi, I. Omuh, and H. I. Okagbue, "Data exploration on factors that influences construction cost and time performance on construction project sites," *Data in brief*, vol. 17, pp. 1320-1325, 2018.
- [22] Y. A. Olawale and M. Sun, "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, 2010.
- [23] G. A. Niazi and N. Painting, "Significant factors causing cost overruns in the construction industry in Afghanistan," *Procedia Engineering*, vol. 182, pp. 510-517, 2017.
- [24] M. A. Musarat, W. S. Alaloul, M. Liew, A. Maqsoom, and A. H. Qureshi, "Investigating the impact of inflation on building materials prices in construction industry," *Journal of Building Engineering*, p. 101485, 2020.
- [25] M. A. Musarat, W. S. Alaloul, and M. S. Liew, "Impact of inflation rate on construction projects budget: A review," *Ain Shams Engineering Journal*, 2020.
- [26] M. A. Musarat, W. S. Alaloul, A. H. Qureshi, and M. Altaf, "Inflation Rate and Construction Materials Prices: Relationship Investigation," in *2020 International Conference on Decision Aid Sciences and Application (DASA)*, 2020, pp. 387-390: IEEE.
- [27] M. Feldkircher and P. L. Siklos, "Global inflation dynamics and inflation expectations," *International Review of Economics & Finance*, vol. 64, pp. 217-241, 2019.

- [28] R. Islam, A. B. A. Ghani, E. Mahyudin, and N. Manickam, "Determinants of factors that affecting inflation in Malaysia," *International Journal of Economics and Financial Issues*, vol. 7, no. 2, pp. 355-364, 2017.
- [29] I. Jaya, W. S. Alaloul, and M. A. Musarat, "Role of Inflation in Construction: A Systematic Review," in *Proceedings of the International Conference on Civil, Offshore and Environmental Engineering*, 2021, pp. 701-708: Springer.
- [30] I. A. Diugwu, E. H. Etuk, D. L. Baba, M. Mohammed, and H. A. Yakubu, "Modelling the Effect of Time Overrun and Inflation Rate on Completion Cost of Construction Projects in Nigeria," *International Journal of Sustainable Construction Engineering and Technology*, vol. 8, no. 2, pp. 18-28, 2017.
- [31] (2019). *Machinery Hire Rates & Equipment Purchase Price*. Available: http://myn3c.cidb.gov.my/cidb_n3c/output/a_web_mne_details.php?4
- [32] (2020). *Historical Inflation Rate Data of Malaysia*. Available: <https://www.dosm.gov.my>
- [33] D. Kornbrot, "S pearman's Rho," *Encyclopedia of Statistics in Behavioral Science*, 2005.