Construction machinery hire rates deviation in Malaysia: an inflation rate effect analysis

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Abstract
Machinery has been used in the construction industry in both small- and large-scale projects for a long time. Machinery is one of the main resources of any construction projects and rates deviation within the hiring of the machinery can result in cost overrun of the project. This study has been conducted to deal with the issue of deviating the machinery hire rates in the construction industry. The study accesses the machinery hire rates and aims to investigate the percentage deviation from 2013 to 2018. In this regard, statistical analysis was conducted to identify the influence of the inflation rate in deviating the machinery hire which results in cost overrun. Also, the interconnectivity of machinery hire rates was evaluated through the correlation coefficient. The analysis shows that the inflation rate possesses a weak relationship with nine and a moderate relationship with five machinery hire rates. However, the interconnectivity of the machinery hire rates was strongly correlated with each other, which emphasize that a change due to the influential factor will affect all the rates and can cause cost overrun. It is therefore recommended to observe other factors which deviate the machinery hire rates within the construction industry.

Keywords: machinery hire rates, percentage deviation, inflation rate, correlation coefficient, construction industry.

Introduction

The construction industry is counted as one of the largest industries and has a vital role in developing the country's economy. A high capital, developing processes and the latest technologies involved in the projects has boost up the construction industry. However, due to various management and financial issues, construction projects are marked with low performance (Alaloul et al., 2020; Erusta & Sertyesilisik, 2019; Le et al., 2020; Musarat & Ahad, 2016; Ranjithapriya & Arulselvan). Usually, the risk of cost overrun is involved in the construction projects which is major distress for the stakeholders (Abd Rahman, 2020; Alaloul et al., 2021; Jaya et al., 2021; Le et al., 2020). Project success can only be achieved if the project budget is viable. Therefore, it is crucial to forecast the budget accurately. Money, materials, manpower and machinery are the essential resources used in construction projects. Thus, it is essential to find out the effect of these resources on deviating the project budget (Alaloul et al., 2019b; Bayram & Al-Jibouri, 2016; Catalão et al., 2019; Firouzi et al., 2016; Mashwama et al., 2016; Memon et al., 2014; Musarat et al., 2021).

Cost overrun is a global issue where out of ten around nine of the construction projects are facing this issue (Aljohani et al., 2017). The variation in the initial budget and the final completing budget ranges from 21% to 55% (Khodeir & El Ghandour, 2019). That is why calculating an exact budget is crucial in achieving project success, as initially, decisions need to be taken on the accessible cost data (Musarrat et al., 2017; Paraskevopoulou & Benardos, 2013). Various researchers worked on cost overrun matter to eliminate it from the construction project, however, it still exists (Aljohani, 2020; Assaad et al., 2020; Klakegg & Lichtenberg, 2016; Musarat et al., 2020b; Musarat et al., 2020c; Paul & Saigal; Rashid, 2020). Most of the construction projects are at greater risk due to the cost overrun resulting in the unsuccessful completion of the projects by exceeding the budget (Memon et al., 2013).

Cost overrun becomes a common phenomenon in Malaysian construction projects. It has been mainstreamed that more than half of the construction projects (55%) faces cost overruns (Shehu et al., 2014). Regrettably, Malaysia's construction industry showing low performance to encounter the cost overrun where the average overrun is 5-10% of the initial price. On the other hand, 53.2% of the public sector and 62.8% of private-sector construction projects are over-budgeted (Abdul Rahman et al., 2012; Endut et al., 2009; Sohu et al., 2018). Even in Malaysia, construction projects are facing cost overrun and machinery rates are considered as one of the critical factors (Memon et al., 2014). A project is considered unsuccessful if it does not meet the budget and face a cost overrun. There could be many possible reasons like change order, social and technical factors, shortage of machinery, or changes in the rates of the machinery. Machinery is an important resource of any construction project and with advancement, the demand for machinery is getting higher (Alaloul et al., 2019a; Alinaitwe et al., 2013; Altaf et al., 2019; Enshassi et al., 2009b).

Table 1 highlights the cost overrun issue which was identified by various researchers through different adopted methods. In the mentioned studies the inflation rate is the ultimate cause of the cost overrun is which affects construction projects all over the world.

Table 1. Cost overrun in various regions. (Self-Elaboration).

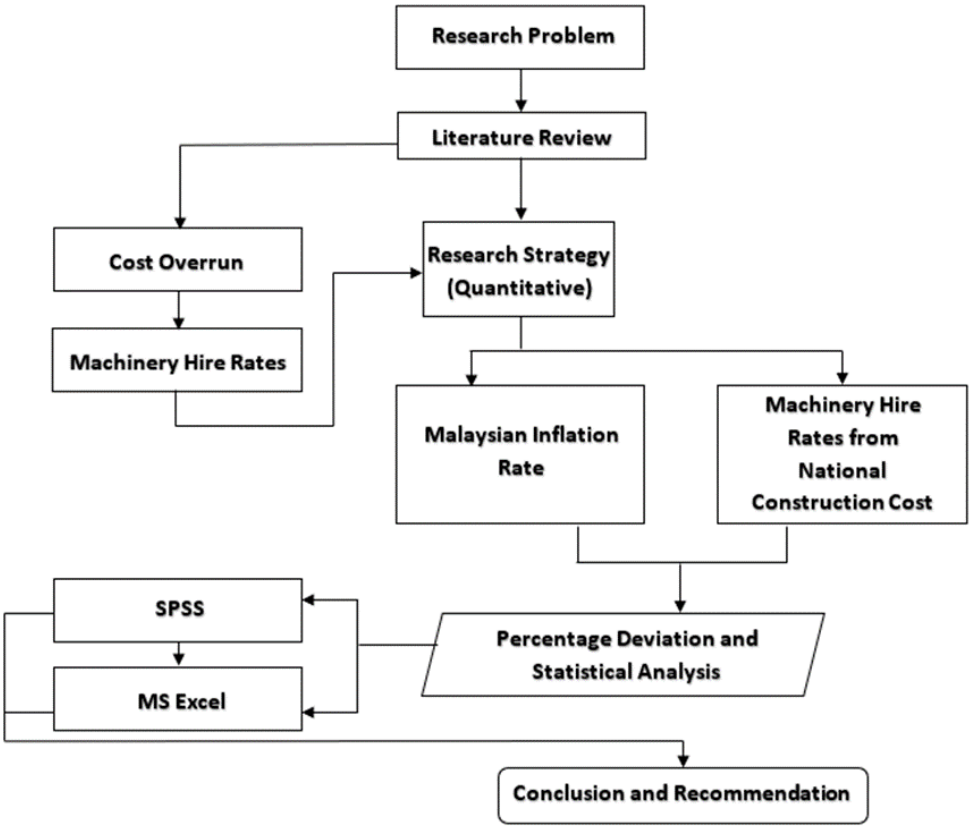
S. No	Study Area	Method	Author & Year
1	United States	Cost escalation of the previous project	Leavitt et al. (1993)
2	UK	Relative Importance Index (RII)	Olawale and Sun (2010)
3	UAE	Weighted score method	Johnson and Babu (2018)
4	Afghanistan	Relative Importance Index (RII)	Niazi and Painting (2017)
5	Zambia	The average weighted perceived significance	Kaliba et al. (2009)
6	Nigeria	Regression Analysis Severity Index	Oghenekevwe et al. (2014) Amusan et al. (2018)
7	India	Comparison of the budgeted and actual cost of a project to calculate cost overrun	Goyal (2017)
8	Malaysia	Bounds Testing Approach Frequency Index	Tang (2014) Haslinda et al. (2018)
9	Uganda	Relative Importance Index (RII)	Alinaitwe et al. (2013)
10	Palestine	Relative Importance Index (RII)	Enshassi et al. (2009a)
11	Vietnam	Spearman's rank correlation test	Le-Hoai et al. (2008)
12	Egypt	Relative Importance Index (RII)	Aziz (2013)

Hence, it is evident that the reason behind the cost overrun is greatly due to the inflation rate which changes annually. With time the inflation rate changes, leaving an adverse effect on the project cost (Jaya et al., 2021; Musarat et al., 2020a). The project cost gets affected when machinery rates changes and the reason behind it is the inflation rate (Alinaitwe et al., 2013; Amusan et al., 2018; Olawale & Sun, 2010). While making a budget for the construction project machinery rates are also incorporated which get affected due to the inflation rate. Therefore, this study aims to examine the changing trend of machinery hire rates and the cause behind it in the Malaysian construction industry. Statistical analysis was performed on individual machinery hire rates to observe the influence of the inflation rate in deviating the rates. Moreover, how the machinery hire rates are interconnected is also evaluated. The study is novel in terms of the relationship investigation which can set a benchmark to evaluate the issue in ongoing construction projects.

Methodology

The methodology of this research is divided into four phases. In the first phase machinery hire rates data was collected, then the arithmetic mean and the standard deviation was calculated for each rate on the available data from 2013 to 2018. In the second phase percentage deviation of the machinery hire rates were calculated to observe the drift of the data. In the third phase, statistical analysis, i.e. correlation test was performed in which a relationship was observed between machinery hire rates and the inflation rate. Lastly, the interconnectivity of the machinery hire rates was determined with the same correlation test. The flowchart of this research is provided in Figure 1:

Figure 1. Research flowchart. (Self-Elaboration).



Data collection

Machinery hire rates data was taken for WP Kuala Lumpur, Malaysia from the National Construction Cost Centre (N3C, 2019), while the inflation rate data was taken from the webpage of Statista (Statista, 2019). The collected data was comprised of Excavator, Dozer, Motor Grader, Lorry and Crane which was further categorized into fourteen subtypes by the concerned department. The reason why only five machinery hire rates were taken is that they were the only types that were available from 2013 to 2018 at the time of conducting this research.

Data analysis

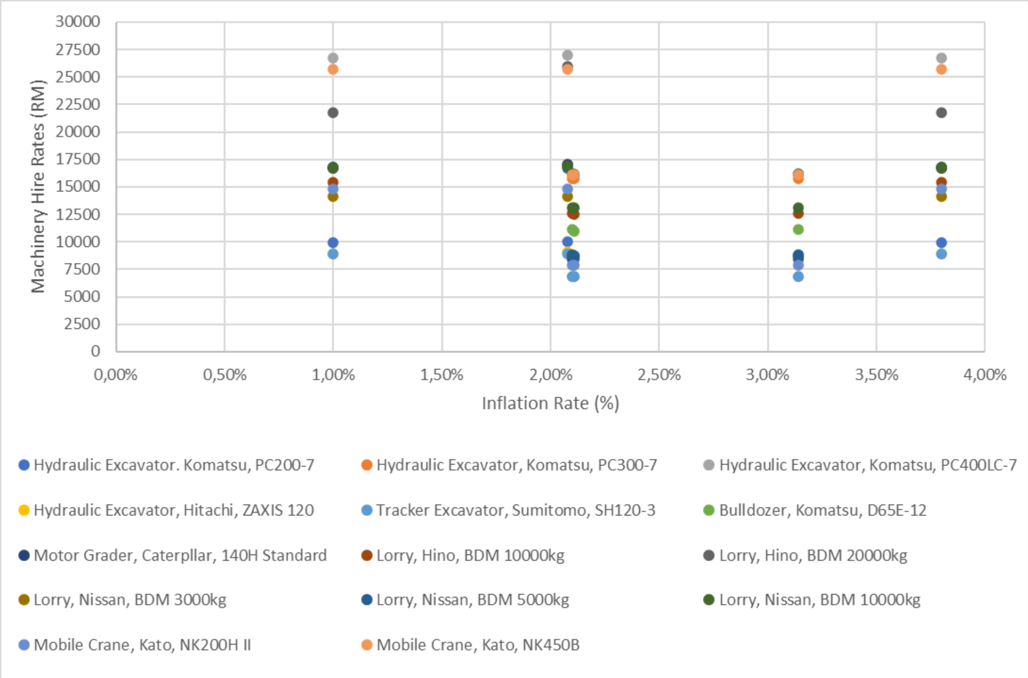
Initially arithmetic mean and standard deviation of the machinery hire rates were computed to observe its central value and how much they are spread out from the mean. To examine the thrust of the rates, the percentage deviation of the machinery hire rates were calculated using Equation 1:

$$\text{Percentage deviation} = \frac{(Current\ year - Previous\ year)}{Previous\ year} \times 100 \qquad (1)$$

Once the percentage deviations of machinery hire rates were calculated, a statistical analysis was performed with the help of the Statistical Package for Social Sciences (SPSS-20). This test shows whether the inflation rate deviates the machinery hire rates or not. Also, how the machinery hire rates are interconnected was examined by using the same test. The correlation coefficient value should always be in between -1 to +1 in which a positive value on the scale of 0.00 – 0.19 possess a very weak relationship, a value from 0.20 – 0.39 possess a weak relationship, a value from 0.40 – 0.59 possess moderate relationship, a value from 0.60 – 0.79 possess a strong relationship and a value from 0.80 – 1.0 possess a very strong relationship. The same value scale is considered for the negative correlation coefficient (Fulton, 2019; Samuel & Okey, 2015).

The inflation rate which is an independent variable was denoted by “x”, whereas the dependent variable, which is the machinery hire rates, was denoted by “y”. The rates were plotted in the scatter graph as shown in Figure 2 to observe the linearity or nonlinearity of the data, as the correlation test varies for both types of data. If the data possess a linear relationship then the Pearson correlation test is performed, however, in the case of a nonlinear relationship, Spearman correlation is recommended (Kornbrot, 2005; Minitab).

Figure 2. Scatter graph of machinery hire rates and the inflation rate. (Self-Elaboration).



From Figure 2, it can be observed that the data possess a nonlinear relationship as all the observations of machinery hire rate are at different intervals without forming a straight linear line. Therefore, the Spearman correlation test was performed.

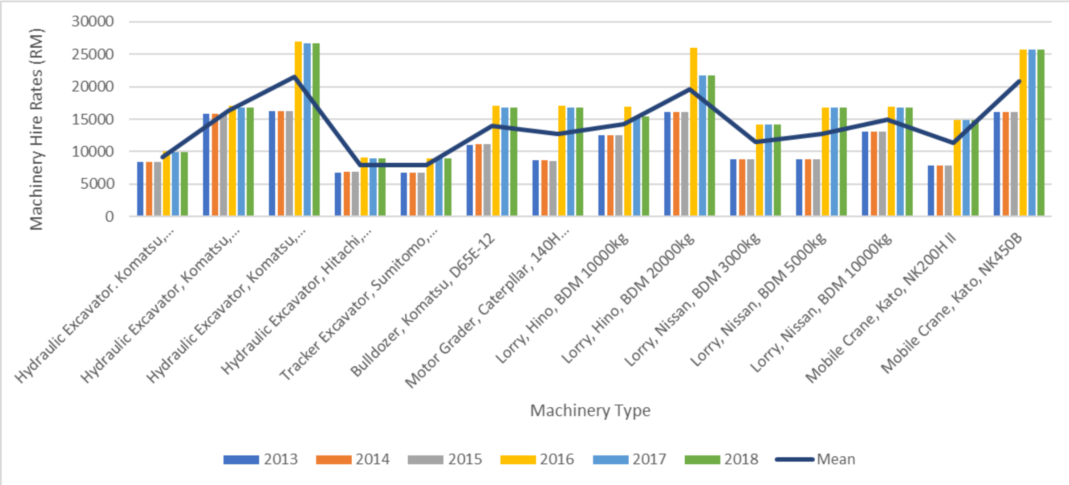
Results and discussion

This section illustrates the results of arithmetic mean, standard deviation, percentage deviation and the correlation coefficient of the fourteen subtypes of machinery hire rates.

Machinery hire rates

The detailed machinery hire rates with arithmetic mean and standard deviation are given in Appendix A. The changing trend of machinery hire rates can be seen in Figure 3.

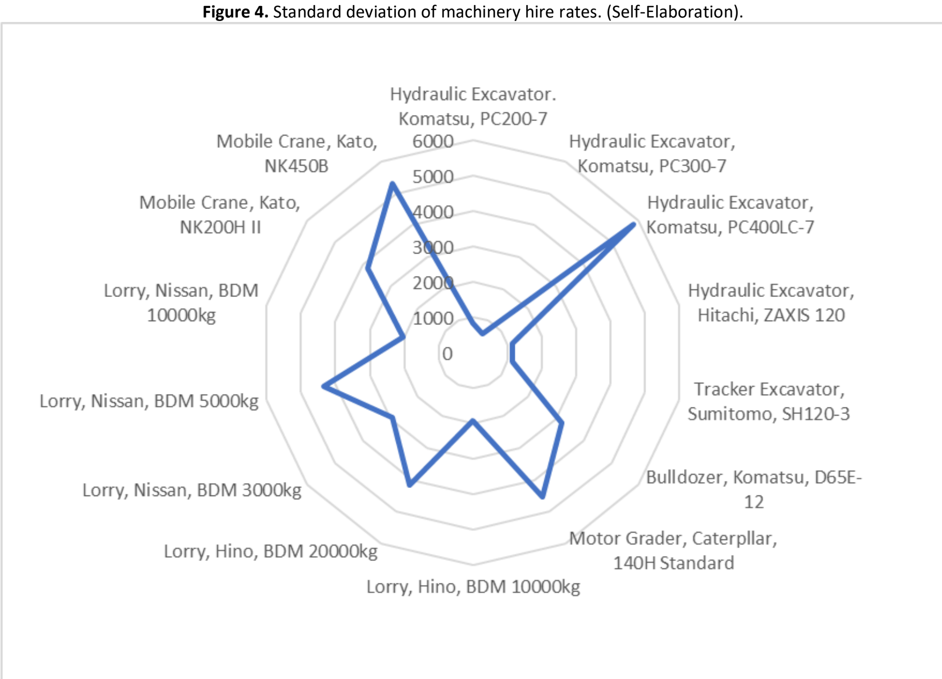
Figure 3. Average machinery hire rates per year. (Self-Elaboration).



Although an increase was recorded in the rates, the pattern was unique. The rates got an increase but with a gap of three years. From the year 2013 to 2015 the rates were nearly the same and got an increase in 2016 which forms the same pattern of constant rates till 2018.

Figure 4 shows the standard deviation of all the machinery hire rates. The highest deviation was observed for "Hydraulic Excavator, Komatsu, PC400LC-7" and "Mobile Crane, Kato, NK450B". The lowest deviation was observed for "Hydraulic Excavator, Komatsu, PC300-7" and "Hydraulic Excavator, Komatsu, PC200-7". Whereas, all other machinery hire rates were showing a moderate deviation in the rates.

Figure 4. Standard deviation of machinery hire rates. (Self-Elaboration).



Percentage deviation calculation

The percentage deviation was computed for all the machinery hire rates by using Equation 1 which are given in Appendix B. The deflection of the rates was observed in a positive as well as in a negative manner. The positive deviation shows an increase, whereas the negative deviation shows a decrease in the rates as compared to the previous year. The deviations in each machinery hire rates are provided in Figure 5 and 6.

Figure 5. Machinery hire rates % increase/decrease (2015-2016). (Self-Elaboration).

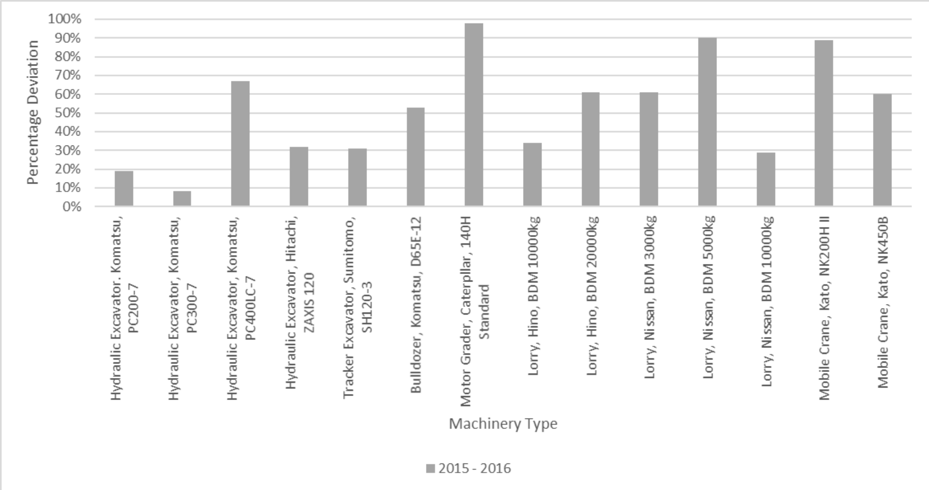
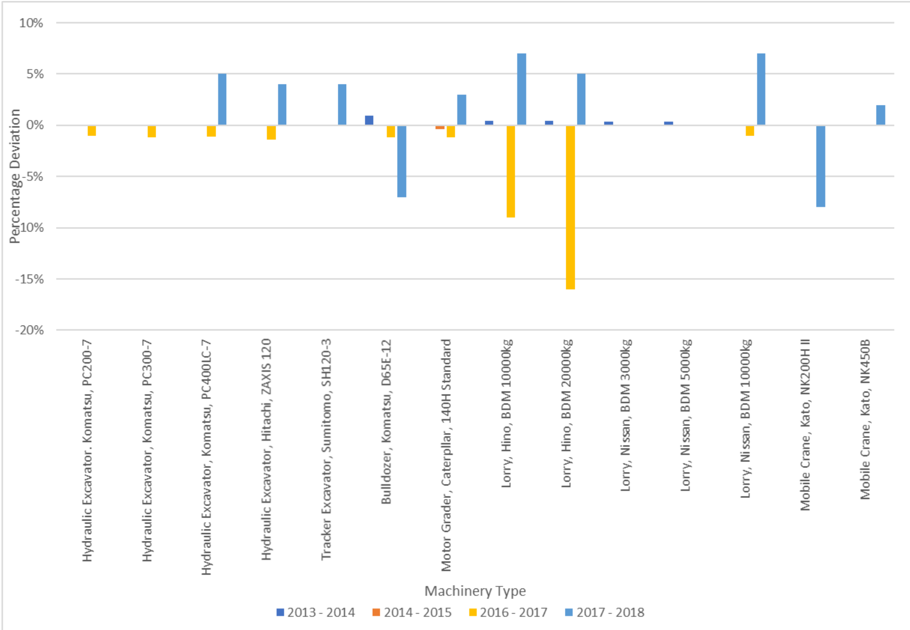


Figure 6. Machinery hire rates % increase/decrease (2013-2014, 2014-2015, 2016-2017, 2017-2018). (Self-Elaboration).



Due to a significant difference in the values and for better representation, percentage deviations were provided separately in two figures. From Figure 5 it can be observed that the deviation mainly occurs during the year 2015 – 2016. Whereas, a very low deviation was recorded in the year 2016 – 2017 as shown in Figure 6. Most of the machinery hire rates showed a 0% deviation during the study period. The overall deviation of machinery hire rates was also calculated. The highest positive deviation was observed as 52% in 2015 – 2016. In 2014 – 2015 and 2017 – 2018, 0% deviation was observed. A negative deviation was also observed as -2% in 2016 – 2017. While in 2013 – 2014 the deviation was only 0.20%.

Spearman correlation

Inflation with Machinery Hire Rates: Several researchers emphasized that the inflation rate is the influential factor in changing the machinery hire rates (Alinaitwe et al., 2013; Amusan et al., 2018; Olawale & Sun, 2010). To observe the phenomena in the Malaysian construction industry, the Spearman correlation test was conducted to determine whether the inflation rate deviates the machinery hire rates or not. The Malaysian inflation rate was transformed from percentage value to percentage deviation so that all the data possesses the same pattern which can easily detect the relationship between inflation rate and machinery hire rates. The inflation rate and its yearly percentage deviation are provided in Figure 7 and the summary of the overall results of Spearman correlation is provided in Table 2.

Figure 7. Inflation rate and percentage deviation. (Self-Elaboration).

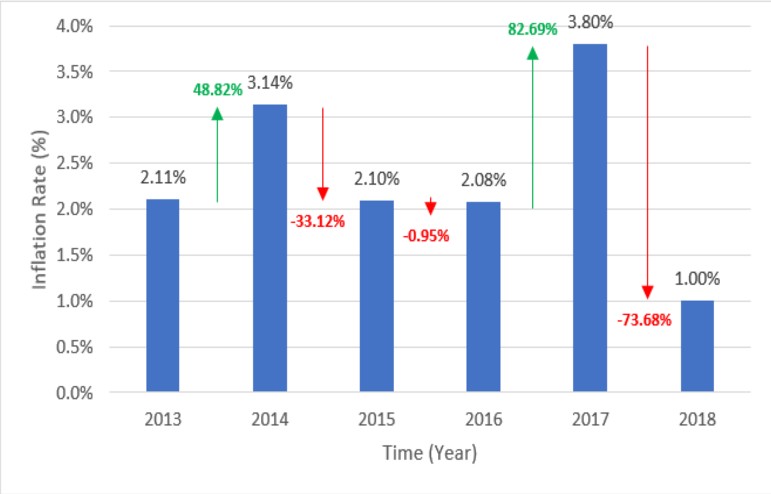


Table 2. Summary of spearman correlation. (Self-Elaboration).

S. No	Correlation Coefficient		Category
	Relationship	Range	Machinery
1	Very Weak	0.00 – 0.19	6
2	Weak	0.20 – 0.39	3
3	Moderate	0.40 – 0.59	5
4	Strong	0.60 – 0.79	0
5	Very Strong	0.80 – 1.0	0

It can be observed from Table 2 that all the machinery hire rates lie on the scale of very weak, weak and moderate relationship. Not a single machinery showed a strong correlation with the inflation rate. The individual results of each machinery hire rates are provided in Table 3.

Table 3. Spearman correlation coefficient (inflation with machinery). (Self-Elaboration).

S. No	Types of Machine	Spearman Correlation Coefficient
1	Excavator	
1.1	Hydraulic Excavator, Komatsu, PC200-7	-0.447
1.2	Hydraulic Excavator, Komatsu, PC300-7	-0.447
1.3	Hydraulic Excavator, Komatsu, PC400LC-7	-0.447
1.4	Hydraulic Excavator, Hitachi, ZAXIS 120	-0.447
1.5	Tracker Excavator, Sumitomo, SH120-3	0.000
2	Dozer	
2.1	Bulldozer, Komatsu, D65E-12	-0.154
3	Motor Grader	
3.1	Motor Grader, Caterpillar, 140H Standard	-0.359
4.0	Lorry	
4.1	Lorry, Hino, BDM 10000kg	-0.154
4.2	Lorry, Hino, BDM 20000kg	-0.154
4.3	Lorry, Nissan, BDM 3000kg	0.224

4.4	Lorry, Nissan, BDM 5000kg	0.224
4.5	Lorry, Nissan, BDM 10000kg	-0.447
5	**Crane**	
5.1	Mobile Crane, Kato, NK200H II	0.000
5.2	Mobile Crane, Kato, NK450B	0.000

Table 3 indicates that none of the machinery categories shows an acceptable relationship between the machinery hire rates with the inflation rate. The highest positive correlation was shown by two subtypes of "Lorry", whereas, the highest negative correlation was shown by four subtypes of "Excavators" and 1 subtype of "Lorry". Overall, no individual machinery is showing a strong correlation, indicating that the inflation rate is not influential in deviating the machinery hire rates. However, the scenario could be different if the number of observations is more, and the correlation test is performed directly between the machinery hire rates and the inflation rate instead of calculating the percentage deviation. As few of the machinery hire rates showed a moderate relationship, therefore, it requires further investigation with larger-scale data.

Correlation among machinery hire rates

To observe how machinery, hire rates are interconnected, a correlation coefficient was also calculated among the different types of machinery. Based on the Spearman correlation, the coefficients are provided in Table 4.

Table 4. Spearman correlation coefficient (among machinery). (Self-Elaboration).

S. No	1.1	1.2	1.3	1.4	1.5	2.1	3.1	4.1	4.2	4.3	4.4	4.5	5.1	5.2
1.1	-	1.000	0.918	0.918	0.750	0.671	0.894	0.894	0.894	0.750	0.750	0.918	0.500	0.750
1.2	1.000	-	0.918	0.918	0.750	0.671	0.894	0.894	0.894	0.750	0.750	0.918	0.500	0.750
1.3	0.918	0.918	-	1.000	0.918	0.359	0.975	0.975	0.975	0.574	0.574	1.000	0.229	0.918
1.4	0.918	0.918	1.000	-	0.918	0.359	0.975	0.975	0.975	0.574	0.574	1.000	0.229	0.918
1.5	0.750	0.750	0.918	0.918	-	0.224	0.894	0.894	0.894	0.500	0.500	0.918	0.250	1.000
2.1	0.671	0.671	0.359	0.359	0.224	-	0.400	0.400	0.400	0.894	0.894	0.359	0.894	0.224
3.1	0.894	0.894	0.975	0.975	0.894	0.400	-	1.000	1.000	0.671	0.671	0.975	0.224	0.894
4.1	0.894	0.894	0.975	0.975	0.894	0.400	1.000	-	1.000	0.671	0.671	0.975	0.224	0.894
4.2	0.894	0.894	0.975	0.975	0.894	0.400	1.000	1.000	-	0.671	0.671	0.975	0.224	0.894
4.3	0.750	0.750	0.574	0.574	0.500	0.894	0.671	0.671	0.671	-	1.000	0.574	0.750	0.500
4.4	0.750	0.750	0.574	0.574	0.500	0.894	0.671	0.671	0.671	1.000	-	0.574	0.750	0.500
4.5	0.918	0.918	1.000	1.000	0.918	0.359	0.975	0.975	0.975	0.574	0.574	-	0.229	0.918
5.1	0.500	0.500	0.229	0.229	0.250	0.894	0.224	0.224	0.224	0.750	0.750	0.229	-	0.250
5.2	0.750	0.750	0.918	0.918	1.000	0.224	0.894	0.894	0.894	0.500	0.500	0.918	0.250	-

A clear understanding can be drawn from Table 4 that how most of the machinery are interconnected and most of them are showed a very strong relationship. "Hydraulic Excavator, Komatsu, PC200-7" showed a very strong relationship which each category, however, a moderate relationship, which is still acceptable, was shown with "Mobile Crane, Kato, NK200H II". "Hydraulic Excavator, Komatsu, PC300-7" showed a very strong relationship which each category, however, a moderate relationship, which is still acceptable, was shown with "Mobile Crane, Kato, NK200H II". "Hydraulic Excavator, Komatsu, PC400LC-7" showed a very strong relationship which each category, however, a weak relationship was shown with "Bulldozer, Komatsu, D65E-12" and "Mobile Crane, Kato, NK200H II".

"Hydraulic Excavator, Hitachi, ZAXIS 120" showed a very strong relationship which each category, however, a moderate relationship, which is still acceptable, was shown with "Lorry, Nissan, BDM 3000kg" and "Lorry, Nissan, BDM 5000kg", and a weak relationship was shown with "Bulldozer, Komatsu, D65E-12" and "Mobile Crane, Kato, NK200H II". "Tracker Excavator, Sumitomo, SH120-3" showed a very strong relationship which each category, however, a moderate relationship, which is still acceptable, was shown with

“Lorry, Nissan, BDM 3000kg” and “Lorry, Nissan, BDM 5000kg”, and a weak relationship was shown with “Bulldozer, Komatsu, D65E-12” and “Mobile Crane, Kato, NK200H II”.

“Bulldozer, Komatsu, D65E-12” showed a strong relationship with a few categories, however, a moderate relationship was observed with “Motor Grader, Caterpillar, 140H Standard”, “Lorry, Hino, BDM 10000kg” and “Lorry, Hino, BDM 20000kg”, and a weak relationship was observed with “Lorry, Nissan, BDM 10000kg” and “Mobile Crane, Kato, NK450B”. “Motor Grader, Caterpillar, 140H Standard” showed a strong relationship with most of the categories, however, a weak relationship was observed with “Mobile Crane, Kato, NK200H II”. “Lorry, Hino, BDM 10000kg” showed a strong relationship with most of the categories, however, a weak relationship was observed with “Mobile Crane, Kato, NK200H II”. “Lorry, Hino, BDM 20000kg” showed a strong relationship with most of the categories, however, a weak relationship was observed with “Mobile Crane, Kato, NK200H II”.

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Most of the Spearman correlation coefficient values are showing a strong relationship which indicates that whatever the influencing factor is, the response of the machinery will be in the same direction. Hence, the situation is a bit more critical as with time, if the inflation rate strike with more intensity, the whole project may suffer just because of the fluctuation of the machinery hire rates. However, further investigation is required and instead of only determining the inflation rate impact on larger observations, the impact of oil prices also needs to determine. It is easily notable that with time oil prices in the market changes drastically. The change in the oil prices can directly affect the machinery hire rates which may result in cost overrun. However, this phenomenon requires further scientific research.

Conclusions

Machinery hire rates are significant for budget development in construction projects. The rates are deviating on annual basis which are ignored in a time of budget development, thus leads towards the project cost overrun. The following are the outcome of the analysis:

- Based on the plotted scatter graph, a nonlinear relationship was observed in machinery hire rates and the inflation rate from the year 2013 to 2018.
- The highest standard deviation was observed for “Hydraulic Excavator, Komatsu, PC400LC-7” and “Mobile Crane, Kato, NK450B”.
- In most of the machinery hire rates an increasing trend was observed but with a pattern where the rates were constant in the year 2013 – 2015 and 2016 – 2018, and the only increase occurred was in 2016.
- Based on the percentage deviation calculation the highest deviation recorded was in the year 2016 – 2017 with an increase of 82.67%. In other years, the deviation was very less and near to zero.
- Spearman correlation results show that the inflation rate is moderately affecting the machinery hire rates where none of the categories shows a strong relationship.
- Spearman correlation results also show that most of the machinery are strongly correlated with each other, except for “Mobile Crane, Kato, NK200H II”, which showed a moderate and weak relationship with most of the machinery category.
- Overall, this scenario highlights the importance of the machinery hire rates in the construction industry and how they can affect the construction project.
- This study needs further investigation for the possible factors that could be deviating the machinery hire rates.

Study limitations and future direction

The analysis is based on the limited amount of data, i.e. from the year 2013 to 2018, as the past machinery hire rates were not available. The study can further be extended by considering any other developing country in which it is easy to get the past data, as the results can significantly change by increasing the study years. It is evident that over time the rates changes, therefore along with the inflation rate, other influencing factors such as oil prices needs to be evaluated further.

Appendix A. Machinery Hire Rates (RM) with Mean and Standard Deviation. (Self-Elaboration).

S. No	Type of Machine	Brand	Model	Specification	Capacity	2013	2014	2015	2016	2017	2018	Mean	Standard Deviation
1	Excavator												
1.1	Hydraulic Excavator	Komatsu	PC200-7	Operating Weight 20785kg	0.93	8426.67	8,426.67	8,426.67	10000	9900	9900	9180.00	826.04
1.2	Hydraulic Excavator	Komatsu	PC300-7	Operating Weight 33490kg	2.3	15,800	15,800	15,800	17033.33	16830	16830	16348.89	605.84
1.3	Hydraulic Excavator	Komatsu	PC400LC-7	Operating Weight 44190kg	3.2	16,200	16,200	16,200	27033.33	26730	26730	21515.56	5823.95
1.4	Hydraulic Excavator	Hitachi	ZAXIS 120	Operating Weight 12000kg	0.5	6,825	6,850	6,850	9033.33	8910	8910	7896.39	1156.30
1.5	Tracker Excavator	Sumitomo	SH120-3	Operating Weight 12000kg	0.5	6,826.67	6,826.67	6,826.67	8910	8910	8910	7868.34	1141.09
2	Dozer												
2.1	Bulldozer	Komatsu	D65E-12	Operating Weight 17890kg	-	11,000	11,100	11,100	17033.33	16830	16830	13982.22	3194.90
3	Motor Grader												
3.1	Motor Grader	Caterpillar	140H Standard	Operating Weight 13552kg	-	8,633.33	8,633.34	8,600	17033.33	16830	16830	12760.00	4533.33
4	Lorry												
4.1	Lorry	Hino	-	BDM 10000kg	10 tonnes	12500	12,550	12,600	16900	15444	15444	14239.67	1926.04
4.2	Lorry	Hino	-	BDM 20000kg	20 tonnes	16,100	16,166.67	16,166.67	26000	21780	21780	19665.56	4153.66

4.3	Lorry	Nissan	-	BDM 3000kg	3 tonnes	8,766.67	8,800	8,800	14157	14157	14157	11472.95	2940.26
4.4	Lorry	Nissan	-	BDM 5000kg	5 tonnes	8,766.67	8,800	8,800	16731	16731	16731	12759.95	4350.09
4.5	Lorry	Nissan	-	BDM 10000kg	10 tonnes	13,100	13,100	13,100	16900	16731	16731	14943.67	2020.58
5	Crane												
5.1	Mobile Crane	Kato	NK200H II	Boom Truck Crane	20MT	7,850	7,850	7,850	14833.33	14850	14850	11347.22	3831.02
5.2	Mobile Crane	Kato	NK450B	Boom Truck Crane	45MT	16,066.67	16,066.67	16,066.67	25740	25740	25740	20903.34	5298.30

Appendix B. Summary of % Deviation of Machinery Hire Rates. (Self-Elaboration).

S.No	Type of Machinery	Brand	Model	Specification	Capacity	13-14	14-15	15-16	16-17	17-18
1	Excavator									
1.1	Hydraulic Excavator	Komatsu	PC200-7	Operating Weight 20785kg	0.93	0%	0%	19%	-1%	0%
1.2	Hydraulic Excavator	Komatsu	PC300-7	Operating Weight 33490kg	2.3	0%	0%	8%	-1.19%	0%
1.3	Hydraulic Excavator	Komatsu	PC400LC-7	Operating Weight 44190kg	3.2	0%	0%	67%	-1.12%	0%
1.4	Hydraulic Excavator	Hitachi	ZAXIS 120	Operating Weight 12000kg	0.5	0%	0%	32%	-1.37%	0%
1.5	Tracker Excavator	Sumitomo	SH120-3	Operating Weight 12000kg	0.5	0%	0%	31%	0.0%	0%
2	Dozer									
2.1	Bulldozer	Komatsu	D65E-12	Operating Weight 17890kg	-	0.91%	0%	53%	-1.19%	0%
3	Motor Grader									
3.1	Motor Grader	Caterpillar	140H Standard	Operating Weight 13552kg	-	0%	-0.39%	98%	-1.19%	0%
4	Lorry									

4.1	Lorry	Hino	-	BDM 10000kg	10 tonnes	0.40%	0%	34%	-9%	0%
4.2	Lorry	Hino	-	BDM 20000kg	20 tonnes	0.41%	0%	61%	-16%	0%
4.3	Lorry	Nissan	-	BDM 3000kg	3 tonnes	0.38%	0%	61%	0%	0%
4.4	Lorry	Nissan	-	BDM 5000kg	5 tonnes	0.38%	0%	90%	0%	0%
4.5	Lorry	Nissan	-	BDM 10000kg	10 tonnes	0%	0%	29%	-1%	0%
5					Crane					
5.1	Mobile Crane	Kato	NK200H II	Boom Truck Crane	20MT	0%	0%	89%	0%	0%
5.2	Mobile Crane	Kato	NK450B	Boom Truck Crane	45MT	0%	0%	60%	0%	0%

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