Journal of Civil and Construction Engineering Research (JCCER)
Volume 1, Issue 1, Date: 31 - December – 2024

Impact Analysis of Equipment Acquisition on Labor Quality of Small-Sized Construction Companies in Metro Manila

Myranda De Mesa [1, *], John Christian Sayson[2], Emmanuel Luis Vasallo[3], and Bienvenido Cervantes[4]
[1, 2, 3, 4] School of Civil, Environmental, and Geological Engineering, Mapua University, Muralla St., Intramuros, Manila
*Corresponding Author

***Abstract*—Equipment is typically one of a construction company's most important assets, substantially affecting its cash flow and profit potential. Construction companies have used a variety of equipment acquisition through different types of work. This study focuses on the impact of the independent variable— types of equipment acquisition—on the dependent variable—labor. Employees from those companies participated in a survey to determine what criteria were considered when choosing an equipment acquisition method and its perceived impact. The study concluded that labor quality for residential projects is only affected by the logistics of acquiring owned equipment.**

Keywords—Acquisition; Construction; Companies; Manila; Analysis.

I. INTRODUCTION

Equipment is usually one of a construction company's significant assets and has a big impact on its cash-flow and potential for profit. The four most popular methods for acquiring construction equipment are paying cash, borrowing money, renting, and leasing. Selecting the finest option for purchasing equipment is one of the most crucial decisions for a construction firm looking to maximize profit. [1] states that there are a minimum of three ways a contractor can guarantee the usage of construction machinery:

1. Purchase the equipment;
2. Rent the equipment; and
3. Rent the equipment with the opportunity to buy it later

Equipment acquisition is one of the basic steps in the pre-construction phase of a project. However, one of the major problems with construction companies is that they require construction equipment but are unsure how to acquire it through buying, renting, or leasing it. An effective project contractor should consider several variables when purchasing the equipment, as these elements have financial and non-financial effects. These aspects should be recognized by a competent construction manager so that it can be evaluated, and the best decisions can be made [2] [3]. based on existing research and available information, renting is the most common method of equipment acquisition among construction companies. this is mainly because additional costs and the responsibilities that come from equipment ownership can be avoided through renting. however, there is insufficient research about how this method, as well as other equipment acquisition methods, impacts small-sized construction companies in terms of the labor quality of their workers. in addition to the lack of contemporary local studies, there has been a gap in information because of the effect of the pandemic on the construction industry. hence, to bridge this gap, this research aims to provide insight and relevant, up-to-date information [4-6].

II. MATERIALS AND METHODS

Quantitative research is the systematic study of phenomena by collecting quantifiable data and applying computer, statistical, or mathematical techniques. For instance, quantitative research collects information via sampling techniques and the dissemination of online surveys, polls, and questionnaires. These data can be used to forecast a service or product's outcome and make any necessary adjustments [3] [7].

To solve problems, quantitative research gathers and examines numerical data from numerous sources. This research type applies to the present study as it aims to identify the effect of equipment acquisition on labor quality [8-12]. This study also uses ANOVA, a statistical analysis method to explain the observed aggregate variability within a data set by separating systematic components from random factors. Systematic factors, not random ones, statistically affect the data set that is being presented [13-19]. Analysts use the ANOVA test in a regression analysis to assess how independent factors affect the dependent variable [20]. Similarly, this study conducts a survey that assigns equipment acquisition as the independent variable and labor quality as the dependent variable that will be examined using ANOVA [21].

In addition to collecting data online, this study was conducted in 2023 in Metro Manila, Philippines. Metro

Received: 21-08-2024
Revised: 30-12-2024
Published: 31-12-2024

Manila is the nation's capital region and one of the most populated regions in the country. The nation's social, political, economic, and cultural life is centered in the city. Since Metro Manila is a region that places a lot of emphasis on projects and development, it may be the perfect location for this study's examination of equipment acquisition for small businesses. Additionally, the researchers developed a survey questionnaire that would be applied during the data collection procedure [22-24].

To complete this study, various online research platforms and applications were used. As a result, this study is carried out for information access in the technological facilities of the Mapua University campus, computer laboratory, and library.

The researchers used a survey questionnaire handed to selected small-sized construction companies [25-28]. The survey questionnaires will be disseminated to the company employees through Google Forms links. The data gathered using the survey will then be analyzed using T-test and Linear Regression to assess the impact of equipment on their respondents' assessment of the labor quality [29-33].

III. Results and Discussion

This chapter presents the research's core findings, delving into an in-depth analysis and interpretation of the results. The empirical data were collected through convenience sampling wherein the respondents are three companies that provide general contracting services - now to be referred to as Company A, Company B, and Company C. An online survey conducted for the employees forms the basis of this discussion, allowing for a comprehensive exploration of the impact of equipment acquisition on labor quality of small-sized construction companies in Metro Manila.

Sample Size
Slovin's Formula

$$n = \frac{N}{1+Ne^2} \quad (1)$$

n = sample size
N = population size
e = margin of error = 5%

$$n = \frac{240}{1 + 240(0.05)^2} \approx 150$$

The population size of Company A, Company B, and Company C were ascertained through directly inquiring from the respective project managers. The total population size of Company A, Company B, and Company C is 240 employees. Hence, sample size calculations are done using Slovin's formula to estimate the required sample size with a 0.05 margin of error. Out of the 240 total population, 166 responses were received from the survey questionnaires disseminated through Google Forms, which exceeds the computed required sample size of 150.

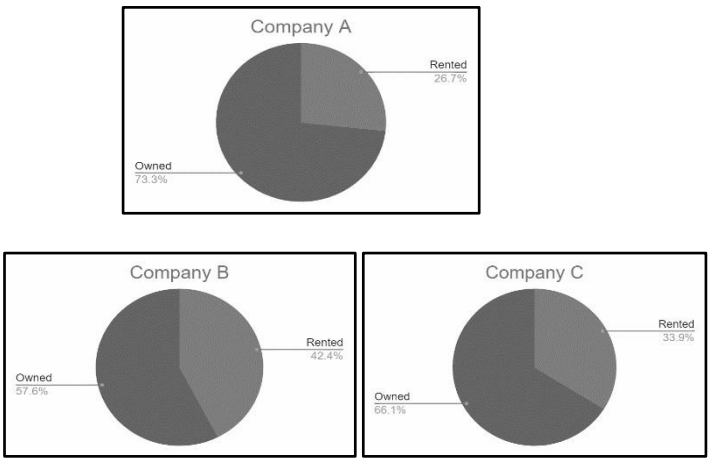

Fig. 1 Predominant Equipment Acquisition Method

The survey questionnaire includes a single-select question about the predominant equipment acquisition method used in the construction project the respondent is currently a part of. The two choices are owned or rented. In Company A, 26.7% percent answered 'rented' while 73.3% of the respondents answered 'owned.' On the other hand, 42.4% of the respondents from Company B answered with 'rented' while 57.6% answered with 'owned'. In Company C, 33.9% percent answered 'rented' while 56.1% of the respondents answered 'owned.'

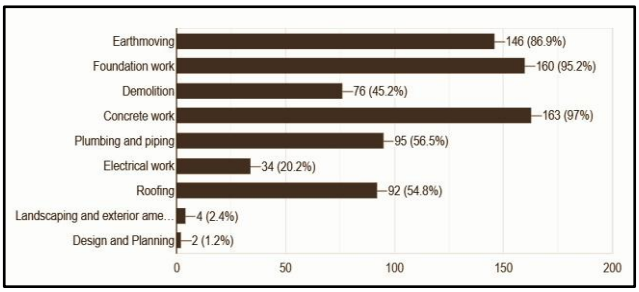

Fig. 2 Type of Task Performed or Supervised

The survey questionnaire also included a multi-select question where the type of task the employee has performed or supervised. This is to refine the construction activities in Company A, Company B, and Company C, wherein the labor quality is impacted by the method of equipment acquisition.

The respondents oversee or engage in concrete work the most, accounting for 97% of the construction activities performed. Other construction tasks showing comparable results to concrete work include foundation work at 95.2%, earthmoving at 86.9%, plumbing and piping at 56.5%, and roofing at 54.8%.

Factors Considered in the Equipment Acquisition. Method-related research articles were used to deduce the common considerations in selecting the equipment acquisition type of small-sized companies in construction projects. The ascertained considerations were integrated into a question structured around a rating scale format to adopt within the research's objective. The respondents were asked to rate the factors from 1 being the least important to 5 being

the most important. Responses were then averaged and ranked from the most to least important for respondents who chose the predominant equipment acquisition method between owned or rented used in the construction project they were a part of.

Among respondents who chose rented as the predominant equipment acquisition type, the equipment price is the most crucial factor, with a 4.59 average. This is followed by overhead cost with a 4.22 average, equipment manufacturer rental rates with a 3.79 average, equipment manufacturer contract offer/bid with a 3.64 average, equipment repair and maintenance cost with a 3.34 average, project type with a 3.22 average, labor considerations with a 2.97 average, and work equipment policy as the least important with a 2.72 average.

On the other hand, among respondents who chose owned as the predominant equipment acquisition type, the project type is the most important factor, with a 4.67 average. This is followed by the price of equipment with a 4.26 average, equipment manufacturer rental rates with a 3.86 average, equipment manufacturer contract offer/bid with a 3.48 average, equipment repair and maintenance cost with a 3.37 average, labor considerations with a 3.19 average, overhead cost with a 3.17 average, and work equipment policy as the least important with an average.

Table 1. Factors Considered by Employees of Companies Using Rented Acquisition Method

Rented

Price of Equipment	4.59
Overhead cost	4.22
Equipment manufacturer rental rates	3.79
Equipment manufacturer contract offer/bid	3.64
Equipment repair and maintenance cost	3.34
Project type	3.22
Labor Considerations	2.97
Work equipment policy	2.72

Table 2. Factors Considered by Employees of Companies Using Owned Acquisition Method

Owned

Project type	4.67
Price of Equipment	4.26
Equipment manufacturer rental rates	3.86
Equipment manufacturer contract offer/bid	3.48
Equipment repair and maintenance cost	3.37
Labor Considerations	3.19
Overhead cost	3.17
Work equipment policy	2.55

Impact of Equipment Acquisition on Labor Quality. The researchers grouped question responses that pertained to the same factors considered in equipment acquisition: Equipment State (Equip_State) and Equipment Logistics (Equip_Logist). Equipment State refers to the condition of the equipment and the frequency of its breakdown leading to maintenance. On the other hand, Equipment Logistics refers to the number of available equipment and/or the readiness of the equipment to be delivered and used for a project at any given time.

Table 3. T-Test Group Statistics for Rented and Owned Acquisition Method.

Acquisition_Type

	Acquisition_Type	N	Mean	Std. Deviation	Std. Error Mean
Equip_State	Rented	58	1.5000	.42920	.05636
	Owned	108	2.9815	1.38909	.13366
Equip_Logist	Rented	58	3.4891	.35501	.04661
	Owned	108	3.2189	.78892	.07591
Labor_Quality	Rented	58	3.5862	.36440	.04785
	Owned	108	4.2338	.67695	.06514

Table 4. T-Test Results for Rented and Owned over Equipment State and Equipment Logistics.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Equip_State	Equal variances assumed	109.150	.000	-7.912	164	.000	-1.48148	.18724	-1.85119	-1.11177
	Equal variances not assumed			-10.213	140.112	.000	-1.48148	.14506	-1.76827	-1.19469
Equip_Logist	Equal variances assumed	28.028	.000	2.475	164	.014	.27025	.10919	.05465	.48585
	Equal variances not assumed			3.034	160.158	.003	.27025	.08908	.09432	.44618
Labor_Quality	Equal variances assumed	24.412	.000	-6.771	164	.000	-.64759	.09564	-.83643	-.45875
	Equal variances not assumed			-8.012	163.994	.000	-.64759	.08082	-.80718	-.48800

An Independent Samples T-test was conducted to verify whether the data acquired between the responses for Rented and Owned categories of equipment acquisition differ for the independent variables about Equipment State and Equipment Logistics and the dependent variable Labor Quality. The p-value used for this test is 0.05 or a 95% confidence interval.

For the state of equipment, the p-value ($p = 0.003$) is less than 0.05, with the Mean Difference not containing zero. This shows a significant difference between the data from the Rented and Owned categories for the Equipment State. Similarly, the Equipment Logistics has a low p-value ($p = 0.000$) with the Mean Difference not containing zero. This also shows a significant difference between the Rented and Owned categories data for equipment logistics. Finally, the p-value for the dependent variable, Labor Quality, is less than 0.05 ($p = 0.001$), and its Mean Difference also does not contain zero. Therefore, there is also a significant difference between the data of Rented and Owned categories for Labor Quality. This showed that separate statistical analyses can be applied for Rented and Owned categories.

Equipment State to Labor Quality. Linear regression was applied to show the estimated impact of the independent variables, Equipment State and Equipment Logistics, on the dependent variable, Labor Quality. Separate linear regression analyses were run for categories of Rented and Owned acquisition types of equipment. A confidence interval of 95% (p = 0.05) was used for all the linear regression.

Table 5. ANOVA Results for Equipment State to Labor Quality of Rented Acquisition Method.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.292	1	.292	2.273	.137[b]
	Residual	7.187	56	.128		
	Total	7.478	57			

a. Dependent Variable: Rent_Labor_Quality

b. Predictors: (Constant), Rent_Equip_State

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.845	.172		22.305	.000
	Rent_Equip_State	-.167	.111	-.197	-1.508	.137

a. Dependent Variable: Rent_Labor_Quality

Using Table 5, the values of the coefficients to model an equation to predict the dependent variable are shown to have a constant value of 3.845 with an incremental change of 0.-167. The linear regression analysis for the Rented type acquisition method has a p-value (p = 0.087) higher than 0.05, thus accepting the null hypothesis. This shows that there is no statistically significant relationship between Equipment State and the Labor Quality for Rented Equipment.

Table 6. ANOVA Results for Equipment State to Labor Quality of Owned Acquisition Method.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.064	1	11.064	30.887	.000[b]
	Residual	37.970	106	.358		
	Total	49.034	107			

a. Dependent Variable: Owned_Labor_Quality

b. Predictors: (Constant), Owned_Equip_State

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.527	.140		25.259	.000
	Owned_Equip_State	.216	.039	.475	5.558	.000

a. Dependent Variable: Owned_Labor_Quality

Using Table 6, the values of the coefficients to model an equation to predict the dependent variable are shown to have a constant value of 3.527 with an incremental change of 0.216. The linear regression analysis for the Owned type acquisition method has a p-value (p = 0.000) lower than 0.05, thus rejecting the null hypothesis. This shows that there is a statistically significant relationship between Equipment State and the Labor Quality for Owned Equipment with a linear model assumed to be:

$$\boldsymbol{y} = \mathbf{3.527} + \mathbf{0.216}(\boldsymbol{x}),$$

where y refers to Labor Quality and x refers to Equipment State. Equipment Logistics to Labor Quality

Table 7. ANOVA Results for Equipment Logistics to Labor Quality of Rented Acquisition Method.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.044	1	.044	.334	.565[b]
	Residual	7.434	56	.133		
	Total	7.478	57			

a. Dependent Variable: Rent_Labor_Quality

b. Predictors: (Constant), Rent_Equip_Logist

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.321	.477		6.965	.000
	Rent_Equip_Logist	.079	.136	.077	.578	.565

a. Dependent Variable: Rent_Labor_Quality

Using Table 7, the values of the coefficients to model an equation to predict the dependent variable are shown to have a constant value of 3.321 with an incremental change of 0.079. The linear regression analysis for the Rented type acquisition method has a p-value (p = 0..565) that is significantly higher than 0.05, thus accepting the null hypothesis. This shows that there is no statistically significant relationship between Equipment Logistics and the Labor Quality for Rented Equipment.

Table 8. ANOVA Results for Equipment Logistics to Labor Quality of Owned Acquisition Method.

Owned

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.392	1	13.392	39.827	.000[b]
	Residual	35.642	106	.336		
	Total	49.034	107			

a. Dependent Variable: Owned_Labor_Quality

b. Predictors: (Constant), Owned_Equip_Logist

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.730	.245		11.160	.000
	Owned_Equip_Logist	.444	.070	.523	6.311	.000

a. Dependent Variable: Owned_Labor_Quality

Using Table 8, the values of the coefficients to model an equation to predict the dependent variable are shown to have a constant value of 2.73 with an incremental change of 0.444. The linear regression analysis for the Owned acquisition method has a p-value (p = 0.000) lower than 0.05, thus rejecting the null hypothesis. This shows that there is a statistically significant relationship between Equipment Logistics and the Labor Quality for Owned Equipment with a linear model assumed to be:

$$\boldsymbol{y} = \mathbf{2.730} + \mathbf{0.444}(\boldsymbol{x}),$$

where y refers to Labor Quality and x refers to Equipment Logistics.

IV. CONCLUSION

This exploratory research aimed to investigate how equipment acquisition type affects the growth of small-sized companies in Metro Manila. To show this, the research mainly focused on the effect of the independent variable,

equipment acquisition types, on the dependent variable, labor quality. The research also showed crucial data supporting the thesis, including the factors considered in selecting the acquisition method. Finally, all the information was aimed to give insight into the most optimal type of equipment acquisition method for the growth of small-sized companies.

Three companies have agreed to participate in the study with agreements about the confidentiality of their business practices. Employees from these companies took part in a survey to help determine the factors considered in selecting a particular equipment acquisition method and its impact on their labor quality.

Statistical treatments were applied to the gathered information to answer the research problem. These treatments included descriptive statistics for demographics and factors in equipment acquisition selection. Meanwhile, T-tests and Linear Regression were applied to show the impact of equipment acquisition on the labor quality, specifically the state of the equipment and logistics in acquiring.

In selecting the type of acquisition method for this equipment, a difference can be seen in the factors considered between companies that have these rented or owned.

According to the gathered data, the factors most considered for rented equipment refer to monetary expenses, precisely the price of equipment, overhead cost, and pricing provided by equipment manufacturers. This reflects the reality of renting, where the budget mainly revolves around prices from external parties that provide the equipment. On the other hand, the factors most considered for owned equipment are the project type and equipment prices. This result reflects a priority in evaluating if the equipment is already available before the prices are considered, which arise only when they need to be acquired.

It can be concluded that labor quality for residential projects is affected by both the state and the logistics of acquiring owned equipment. On the other hand, neither of the factors mentioned earlier affects the labor quality when acquiring equipment by renting. Therefore, based on these results, the study shows that the owned equipment acquisition method is more optimal than renting for the growth of a small-sized company.

REFERENCES

[1] A. Ridhuan and B. Wahid, "An exploratory study of factors affecting the acquisition method of construction equipments and machineries among G7 contractors," 2016. [Online]. Available: https://etd.uum.edu.my/5501/1/s815156_01.pdf

[2] P. Bhandari, "What is quantitative research? Definition, uses & methods," Scribbr, Nov. 24, 2022. [Online]. Available: https://www.scribbr.com/methodology/quantitative-research/

[3] K. Manoharan et al., "Labour-related factors affecting construction productivity in Sri Lankan building projects: perspectives of engineers and managers," Front. Eng. Built Environ., vol. 2, no. 4, 2022. doi: 10.1108/febe-03-2022-0009

[4] S. Bugad, "Maintenance management of construction equipment on construction project," Int. Res. J. Eng. Technol., vol. 6, no. 6, pp. 3619–3623, 2019.

[5] R. Buma, "Construction, project management, reporting," ProjectManager.com, Sep. 3, 2021. [Online]. Available: https://www.projectmanager.com/blog/construction-quality-control

[6] S. S. Chandra et al., "Assessing factors affecting construction equipment productivity using structural equation modeling," Buildings, vol. 13, no. 2, p. 502, 2023. doi: 10.3390/buildings13020502

[7] "Construction equipment rental: Reducing risk and emissions," 2020. [Online]. Available: https://www.hitachicm.eu/wp-content/uploads/2020/08/RENTAL_WHITEPAPER.pdf

[8] G. Ellis, "Construction quality management 101," Digital Builder, May 17, 2021. [Online]. Available: https://constructionblog.autodesk.com/construction-quality-management-10/

[9] D. Fleetwood, "Quantitative research: What it is, tips & examples," QuestionPro. [Online]. Available: https://www.questionpro.com/blog/quantitative-research/

[10] A. T. Gumu and A. A. Aibinu, "Construction equipment management practices for improving labor productivity in multistory building construction projects," ASCE, pp. 1–13, 2017.

[11] M. Gunduz and A. Abu-Hijleh, "Assessment of human productivity drivers for construction labor through importance rating and risk mapping," Sustainability, vol. 12, no. 20, p. 8614, 2020. doi: 10.3390/su12208614

[12] Indhu and Yogeswari, "Review on delay factors due to improper construction equipment management," Int. J. Emerg. Technol., vol. 11, no. 1, pp. 209–214, 2020.

[13] Institution of Civil Engineers and the Actuarial Profession, Risk Analysis and Management for Projects (RAMP), 2nd ed. London: Thomas Telford Ltd, 2005.

[14] K. A. Shamsuddin et al., "Investigation the safety, health and environment (SHE) protection in construction area," Int. Res. J. Eng. Technol., vol. 2, no. 6, pp. 624–636, 2015. [Online]. Available: https://www.researchgate.net/profile/Khairul-Akmal-Shamsuddin/publication/282747785

[15] D. Jagtap and A. Tidke, "Factor affecting labour productivity in building construction," J. Emerg. Technol. Innov. Res., vol. 6, no. 3, 2019. [Online]. Available: https://www.jetir.org/papers/JETIR1903J26.pdf

[16] J. M. Wilson Jr. and E. Koehn, "Safety management: Problems encountered and recommended solutions," J. Constr. Eng.

[17] Int. Res. J. Eng. Technol. (IRJET), "Selection criteria of equipment in construction project," Academia.edu, Aug. 19, 2017. [Online]. Available: https://www.academia.edu/34273556/

[18] Leavitt Machinery, "The 4 methods of equipment acquisition," Nov. 23, 2018. [Online]. Available: https://www.leavittmachinery.com/blog/ace-coustol/2015/11/23/the-4-methods-of-equipment-acquisition

[19] C. Liu, Z. Lei, D. Morley, and S. M. AbouRizk, "Dynamic, data-driven decision-support approach for construction equipment acquisition and disposal," ASCE, pp. 1–12, 2020.

[20] A. Azmi, D. K. Ahmad, and M. Danish, "Selection criteria of equipment in construction project," Int. Res. J. Eng. Technol. (IRJET), vol. 4, no. 7, pp. 2328–2335, Jul. 2017.

[21] Z. Ma, Y. Ren, X. Xiang, and Z. Turk, "Data-driven decision-making for equipment maintenance," Autom. Constr., vol. 112, p. 103103, 2020. doi: 10.1016/j.autcon.2020.103103

[22] R. E. McClay, "Toward a more universal model of loss incident causation," Prof. Saf., Jan. 1989, pp. 15–20.

[23] C. P. Pham et al., "Risk factors affecting equipment management in construction firms," J. Asian Finance Econ. Bus., vol. 7, no. 11, pp. 347–356, 2020. doi: 10.13106/jafeb.2020.vol7.no11.347

[24] S. W. Poon, S. L. Tang, and F. K. W. Wong, Management and Economics of Construction Safety in Hong Kong, Hong Kong: Hong Kong University Press, 2008.

[25] F. Aziz and C. Willis, "An investigation of construction company overhead costs in Guyana," Int. J. Account. Res., 2021. [Online]. Available: https://www.walshmedicalmedia.com/open-access/an-investigation-of-construction-company-overhead-costs-in-guyana.pdf

[26] J. Ridley, Safety at Work, 2nd ed. London: Butterworth Ltd, 1986.

[27] M. N. Sajoudi, M. K. Sadi, A. Abdullah, and M. Kasraei, "Factors affecting construction equipment acquisition methods in Malaysia," in Proc. Colloquium on Humanities, Science and Engineering Research (CHUSER), Dec. 2017, pp. 471–475.

[28] S. Sirisilla, "Experimental research design — 6 mistakes you should never make!" Enago Academy, Jan. 19, 2023. [Online]. Available: https://www.enago.com/academy/experimental-research-design/

[29] A. Supriatna, M. L. Singgih, E. Widodo, and N. Kurniati, "Overall equipment effectiveness evaluation of maintenance strategies for rented equipment," Int. J. Technol., vol. 11, no. 3, pp. 619–627, 2020. doi: 10.14716/ijtech.v11i3.3579
[30] A. T. Swenson and J. Deere, "Equipment acquisition choices: Making the right choice in today's financial environment," pp. 93–99, 2019.
[31] S. Tenepalli, S. S. Asadi, and K. Sai Kala, "A model study on comparative cost analysis of equipment management in construction companies in Tirupati region," Int. J. Civ. Eng. Technol., vol. 8, no. 1, pp. 72–81, 2017. [Online]. Available: https://iaeme.com/MasterAdmin/Journal_uploads/IJCIET/VOLUME_8_ISSUE_1/IJCIET_08_01_008.pdf
[32] K. Tijanić, M. Šopić, I. Marović, and D. Car-Pušić, "Analysis of the construction machinery work efficiency as a factor of the earthworks sustainability," IOP Conf. Ser.: Earth Environ. Sci., vol. 222, no. 1, p. 012009, 2019. doi: 10.1088/1755-1315/222/1/012009
[33] N. V. Tam, N. Q. Toan, D. T. Hai, and N. L. D. Quy, "Critical factors affecting construction labor productivity: A comparison between perceptions of project managers and contractors," Cogent Bus. Manag., vol. 8, no. 1, p. 1863303, 2021. doi: 10.1080/23311975.2020.1863303