The Identification and Impact of Constraints in the Quality of Construction Projects in Manila, Philippines

Hans Jericho Francisco[1], Yasmin Hannah De Ocampo[1], Patricia Danielle Evangelio[1], Jocelyn S. Buluran[1]

[1] Mapua University, 1002 Manila, Philippines
hjtfrancisco@mymail.mapua.edu.ph, yhjdeocampo@mymail.mapua.edu.ph, pdzevangelio@mymail.mapua.edu.ph, jsbuluran@mapua.edu.ph

Abstract

Infrastructure development in the Philippines is still not included in the contemporary construction projects being expedited globally. The construction industry in the Philippines specifies the following general construction restrictions: economic, legal, environmental, technical, and social constraints. Therefore, it is crucial to study the Philippines' construction constraints to effectively alleviate it. In this study, a survey of professionals in the construction industry was conducted about their construction experience in the city of Manila focusing on construction constraints. The Likert scale and statistical analyses such as Simple Linear Regression and Multiple Linear Regression were used due to the number of variables in the study. Results show that environmental constraints correlate the highest with quality of construction (0.6288) whereas economic, legal, and technical constraints are seen with moderate correlation (0.4575, 0.5745, and 0.5797, respectively), while social constraint is seen to have the lowest correlation coefficient in the quality of construction (0.39). The study suggests that the actions done in a construction project should be thoroughly checked for its environmental constraints. The researchers recommend that a different statistical method should be utilized, to represent the working population in the construction industry more accurately. To produce more accurate results, the sample size and study's target respondents should be increased. Lastly, the addition of respondents from different fields of engineering should be treated equally to avoid bias in the analysis.

Keywords

Construction Constraints, Philippine Construction, Construction Quality, Simple Linear Regression Analysis, Multiple Linear Regression Analysis

1. Introduction

The current state of construction performance of the Philippines, considering the lack of reliability, safety, and significant improvements, ranks the country at the lower bottom of the World Economic Forum's Global Competitiveness Report (WEF, 2017). Relative to other countries in the Association of Southeast Asian Nations (ASEAN), the quality and quantity of public infrastructure and infrastructure investment are low in the Philippines. With the subpar performance of the country in the construction industry worldwide, the researchers of the study suggest identifying the general construction constraints that affect the deterioration of the country's performance in the infrastructure sector, as well as associating these constraints with its impact on the quality of construction projects. Quality in the construction industry is distinguished as the attainment of the satisfaction of the customer, and the accomplishment of the client's or owner's requirement within a specified budget (Abas et al., 2015). With the critical requirements mentioned that aid in the accomplishment of the project, there lies a need for conducting a study specifically in Manila, the capital of the Philippines. The study's main objective is to identify the main construction constraint and its impact on the quality of construction projects in Manila, Philippines. The study aims to determine the relationship between construction constraints focusing on quality in construction projects. Hence, researchers of the study particularly identify the impact of construction constraints on the quality of construction projects using Linear Regression Analysis, determines the major construction constraint from the five categories: economic, legal, environmental, technical, and social, and provides the importance of determining the major construction constraint. The researchers limit the study to a survey on construction professionals comprising of engineers, architects, contractors, builders, and professors that are aware of numerous constraints evident in Manila projects. Gathering the acquired information, the researchers focus on how to eliminate the construction constraints and itemize the importance of its identification.

2. Methodology

The survey questionnaire was adapted from Bhavsar and Solanki (2020) that was used to collect the response of construction professionals through the Likert Scale. Bhavsar and Solanki (2020) used a five-point Likert Scale as the quality performance indicator where the measurement of the data was specified as 5 – extremely high, 4 – high, 3 – medium, 2 – low, and 1 – exceptionally low. The survey was conducted through Google Forms and was analyzed by using a mixed methodology.

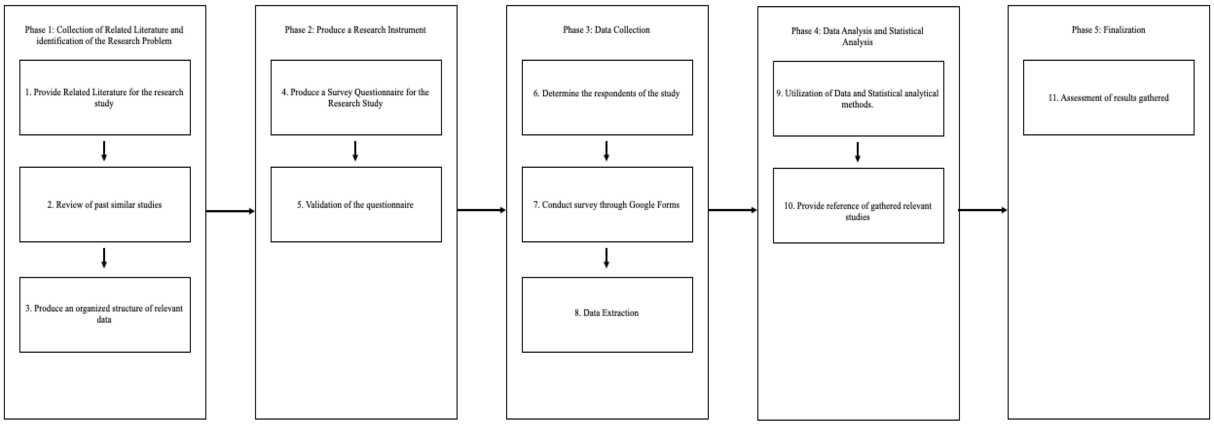

Figure 1. Conceptual Framework in a Flowchart

Using Multiple Linear Regression, the data gathered from the survey questionnaire was interpreted based on the quality performance level chosen by the respondents and was compared to data analyzed in previous studies. The factors affecting each construction constraint were specified as limiting factors. The limiting factors on the quality of construction projects were identified to be the dependent variable (X). Meanwhile, the quality performance level rated by the respondents was identified to be the independent variable (Y).

CONSTRUCTION CONSTRAINTS		QUALITY PERFORMANCE LEVEL				
		1	2	3	4	5
Economic Constraints	Soundness in financing the project by the owner					
	Promising of completion of project					
	Difficulties in obtaining loan from financiers					
	Improper allocation of money to related parties					
Legal Constraints	Difficulties in obtaining work permits					
	Land acquisition					
	Chances of change in drawing/ design					
	Building Regulations					
	Safety Regulations					
	Disputes related to contractual documents					
	Work laws (of the current government)					
	Non-availability of land within city limits					
	NOCs from different departments					
Technical Constraints	Practicability of completing the project in given duration					
	Delay in solving problems					
	Inappropriate project cost estimation					
	Imperfect drawings & details					
	Unavailability of skilled Engineers and Project Managers					
	Established labs (for material testing) present or not at the place of execution					
	Unavailability of storage space					
	Restricted site area					
	Poor condition between different agencies					
	Improve resource levelling					
	Improper power delegation					
	Poor planning & scheduling					
Social Constraints	Politicking (politics)					
	Orthodox beliefs of people					
	Ownership of the problems					
	Media (their honesty & dishonesty)					
	Emotional constraints					
	Inadequate compensation for the land					
Environmental Constraints	Environmental clearance certificate					
	Weather effect on execution activities					
	Air, water, or ground pollution					
	Noise and dust pollution					
	Traffic & transport					
	Topographic & Soil strata					

Figure 2. Types of Construction Constraints using Likert Scale

Multiple Linear Regression

$$y_1 = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 \quad (1)$$

The independent variable (x) is the Construction Constraint where x_1 is Economic Constraint, x_2 is the Legal Constraint, x_3 is the Environmental Constraint, x_4 is the Technical Constraint, and x_5 is the Social Constraint. Meanwhile, the dependent variable (y) is the Quality of Construction Projects. The data was analyzed using Microsoft Excel to identify the R-Square and p-value of the coefficients. These are significant residuals in the Multiple Linear Regression Analysis that was used to recognize the relationship between the independent and dependent variable.

3. Results

3. 1 Demographics of Respondents

PROFESSION	NO. OF RESPONDENTS	PERCENTAGE	AGE RANGE
Civil Engineer (22-62)	31	57%	22-62
Architect (25-48)	7	13%	25-48
Project Manager (37-63)	5	9%	37-63
Production Manager (36)	1	2%	36
Contractor (30-57)	5	9%	30-57
Interior Designer (24)	1	2%	24
Electrical Engineer (29-45)	3	6%	29-45
Senior Construction Manager (36)	1	2%	36

Table 1. Demographic Profile of Respondents

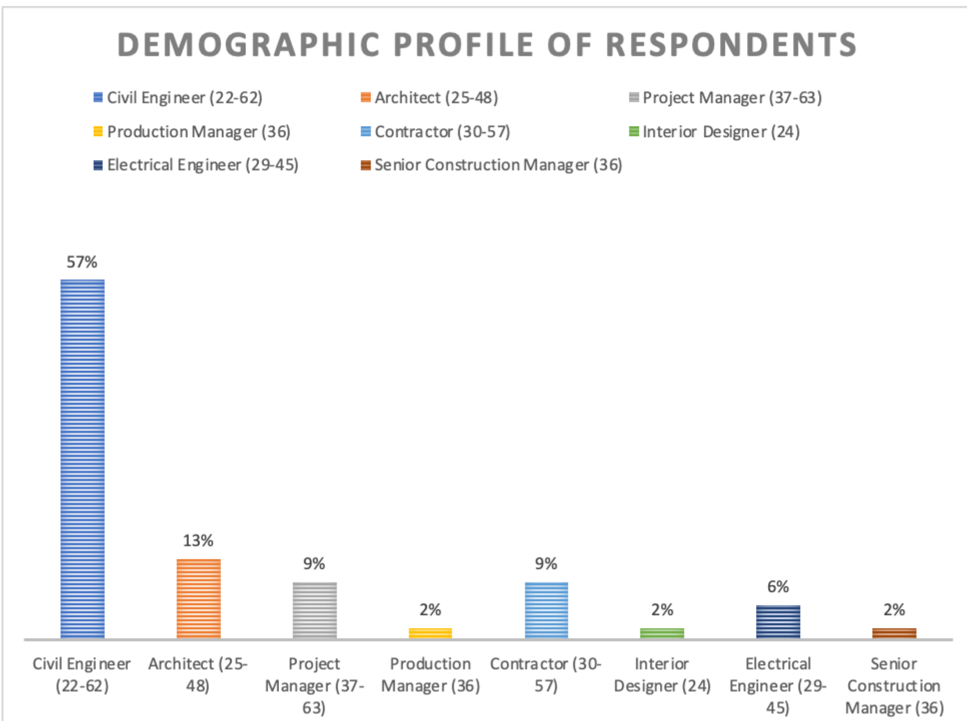

Figure 2. Demographic Profile of Respondents

In Multiple Linear Regression, an independent variable would be deemed significant to the dependent variable, as such each constraint was individually tested to prove for significance and to know which was the most significant. The respondents of the study are specialists from different fields in the construction industry. These are: Civil

Engineers, Architects, Project Managers, Production Managers, Contractors, Interior Designers, Electrical Engineers, and Senior Construction Managers. The respondents are professionals that have construction experience in the City of Manila, Philippines.

3.2 Correlation

CONSTRUCTION CONSTRAINTS	QUALITY
Economic	0.4575086
Legal	0.5744771
Environmental	0.6287575
Technical	0.5796774
Social	0.3943669

Table 1.2 Correlation Coefficients of Construction Constraints

4. Discussion

Correlation in the data quantifies the linear relationship between the dependent variable, Quality of Construction Project, and independent variable, Construction Constraints. It was observed that all coefficient values are positive, indicating that the two variables are directly proportional to each other. BMJ (n.d.) indicated that correlation coefficients ranging from 0.2-0.39 are very weak, 0.4-0.59 are moderate, and 0.6-0.79 are strong. As observed from Figure 1.2, Social Constraint has a correlation coefficient of 0.39, indicating a weak correlation. Meanwhile, Economic, Legal, and Technical Constraint has a correlation coefficient of 0.4575, 0.5745, and 0.5797 respectively, indicating a moderate correlation. Among the correlation coefficients, Environmental Constraint has the highest coefficient with a coefficient of 0.6288.

Simple Linear Regression

ECONOMIC

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.457508579
R Square	0.2093141
Adjusted R Square	0.194108602
Standard Error	0.462145547
Observations	54

LEGAL

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.574477097
R Square	0.330023935
Adjusted R Square	0.317139779
Standard Error	0.425408751
Observations	54

ENVIRONMENTAL

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.628757534
R Square	0.395336036
Adjusted R Square	0.383707883
Standard Error	0.404141844
Observations	54

TECHNICAL

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.57967741
R Square	0.336025899
Adjusted R S	0.323257167
Standard Err	0.423498957
Observation:	54

SOCIAL

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.394366903
R Square	0.155525254
Adjusted R S	0.139285355
Standard Err	0.477606368
Observation:	54

MULTIPLE LINEAR REGRESSION ANALYSIS

Regression Statistics	
Multiple R	0.767980701
R Square	0.589794356
Adjusted R Square	0.547064602
Standard Error	0.346464422
Observations	54

ANOVA

	df	SS	MS	F	Significance F
Regression	5	8.284332232	1.656866446	13.80289596	2.32155E-08
Residual	48	5.7618046	0.120037596		
Total	53	14.04613683			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1.373300072	0.307643688	4.463930604	4.86693E-05	0.754740981	1.991859164	0.754741	1.991859164
ECONOMIC	0.027064937	0.070595299	0.383381568	0.703129676	-0.114876426	0.169006299	-0.114876	0.169006299
LEGAL	0.139960802	0.061406842	2.279237915	0.027139651	0.016494072	0.263427533	0.016494	0.263427533
ENVIRONMENTAL	0.148825834	0.068019309	2.187993929	0.033570434	0.012063848	0.28558782	0.012064	0.28558782
TECHNICAL	0.130153397	0.062072088	2.09681035	0.041304074	0.005349099	0.254957695	0.005349	0.254957695
SOCIAL	0.16756516	0.063697336	2.630646277	0.011421643	0.039493082	0.295637238	0.039493	0.295637238

Figure 1.3 Simple Linear and Multiple Linear Regression Results for Construction Constraints

The R Square in the data analysis indicates that out of the five (5) construction constraints, the environmental constraint has the highest R Square, indicating that it is the most significant construction constraint in the quality of construction projects in Manila. Furthermore, for the Multiple Linear Regression, the R Square is computed to be 0.58979 which indicates that 58.98% of the Quality Impact in Construction Projects are due to economic, legal, environmental, technical, and social constraints. The statistical significance F is $2.32 \mathrm{x} 10^{-8}$. Since the significance value is less than 0.05, it indicates that the model fits the data in the sense that construction constraints can predict the quality of construction projects in Manila. The line fit plots illustrated above in Figure 1.4 reinforces this.

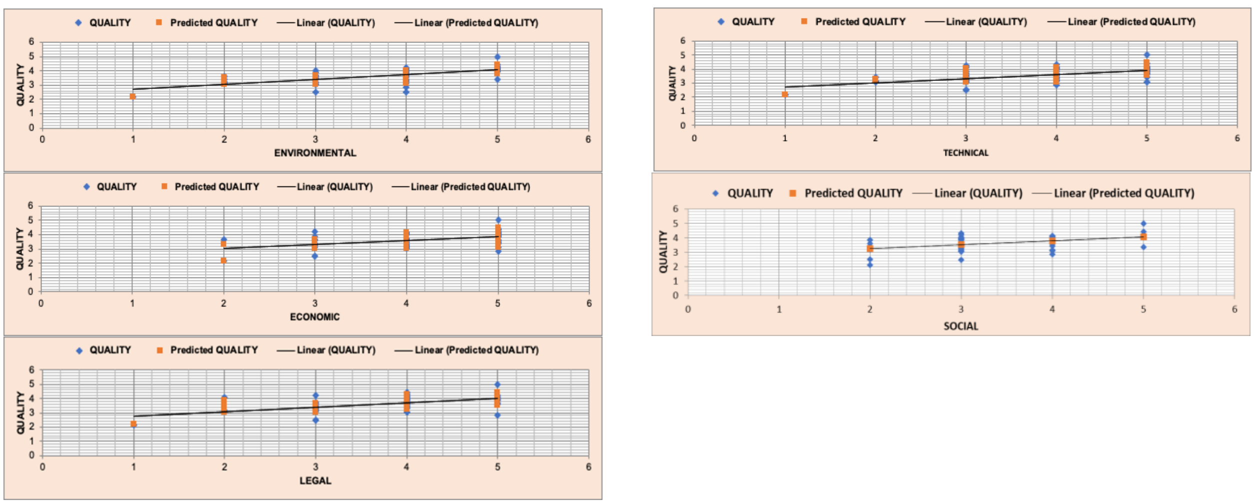

Figure 1.4 Line Fit Plots of Constraints

5. Conclusions

General construction constraints are divided and classified by the construction industry as economic, legal, environmental, technical, and social constraints. Giving the idea that the construction industry is focused on satisfying and accomplishing customer satisfaction and its requirements to a specified budget (Abas et al., 2015). This study identified a relationship between each construction constraint and the quality of construction projects, determined the major construction constraint from the five constraints, and provided the importance of determining the major construction constraint. Moreover, the group formulated a mixed methodology using Linear Regression Analysis to determine the connection between construction constraints to the quality of construction projects. Furthermore, the researchers analyzed the data through Correlation, Simple Linear, and Multiple Linear Regression Analysis designated the relationship between the dependent variable, quality of the construction project, and the independent variable, construction constraint. The correlation indicated that environmental constraint has the highest correlation with a correlation coefficient of 0.6288. This indicates that the correlation between the environmental constraint and the quality of the construction project is extraordinarily strong and directly proportional. The Simple Linear Regression Analysis indicates that the environmental constraint has the highest R Square with a value of 0.3933 denoting that 39.33% of the quality impact in construction projects is due to environmental constraint.

In Multiple Linear Regression Analysis, the p-values of the Legal, Environmental, Technical, and Social are less than 0.05, indicating that there is a significant relationship between these construction constraints to the quality of construction projects in Manila. This indicates that these constraints do affect the quality of construction projects in Manila. Meanwhile, the p-value for economic constraint is greater than 0.05 but having a p-value less than 0.05 using Simple Linear Regression Analysis thus being disregarded from the data analysis. Other statistical methods hold a significant value for environmental constraint hence indicating that it is the major construction constraint for this study. This shows that environmental concerns have a significant impact on the quality of construction projects. Thus, it is necessary to conduct a thorough risk assessment to lessen environmental problems having considerable impact on the project's overall performance for increased customer satisfaction and sturdy and safe construction.

References

Abas, M., Khattak, S. B., Hussain, I., Maqsood, S., & Ahmad, I. (2015). Evaluation offactors affecting the quality of construction projects. Technical Journal, University of Engineering and Technology (UET) Taxila, Pakistan, 20(2), 115-120.

Bhavsar, U. M., & Solanki, J. V. (2020). Identification Of Constraints In Construction Projects. *Int. Research. J. Eng. Technol*, *7*, 6302-6307.

BMJ. (n.d.). 11. Correlation and Regression. https://www.bmj.com/aboutbmj/resources-readers/publications/statistics-square-one/11-correlation-andregression

Lim, L., & WASHIO, K. (2018). The Current State of Philippine Infrastructure and the Government’s Plans for the Future. *The Chuo-Gakuin University Review of Economics & Commerce* (中央学院大学商経論叢), 32(2), 107-116.

World Economic Forum (WEF). (2017). Global Competitiveness Report. 2017-2018. Retrieved from: http://reports.weforum.org/global-competitiveness-index- 2017-2018/