

# **PROJECT MONITORING AND COMPLETION TIME OF SELECTED WASTE MANAGEMENT COMPANIES IN LAGOS STATE**

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## **ABSTRACT:**

The rapid rise in global population, urbanization, and economic progress has led to a significant increase in solid waste generation. This surge presents substantial environmental, health, and social hazards. This study aims to investigate the impact of solid waste management on project completion time in specific enterprises in Lagos State. The study utilised a survey research design. Stratified random sampling technique was employed to select 129 staff members from the waste management professionals. Data was obtained from a primary source using a structured questionnaire. Simple and Multiple Regression analysis were used to test relevant hypotheses. The study revealed a moderate positive correlation between field visits and timely delivery. The study revealed a moderate positive correlation between the project schedule chart and timely delivery. The correlation coefficient is 0.508, which is equivalent to 50.8%. There is a significant positive correlation between field visits, project schedule charts, and the timely delivery of projects. It was therefore recommended that adequate field visit and accurate project schedule should be adopted by the waste management companies in order to improve their timely delivery of their projects.

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## Introduction

The rapid rise in global population, urbanization, and economic progress has led to a significant increase in solid waste generation (Fan et al., 2020). This surge presents substantial environmental, health, and social hazards (Fan et al., 2020). Developed countries have adopted advanced project monitoring techniques, such as frequent field visits and detailed project schedules, to effectively manage waste and promote recycling and reuse (Fan et al., 2020). However, developing countries face distinct challenges.

Developing countries often generate a higher proportion of inert waste, like dust, sand, and stones (Nabil, 2019). Additionally, the extensive consumption of fresh fruits and vegetables contributes to high moisture content in their waste streams (Nabil, 2019). This unique waste composition, combined with limited technological resources, hinders effective waste management (Nabil, 2019). Furthermore, the lack of adoption of new project monitoring approaches further impedes efficient waste management (Nabil, 2019).

Olusegun (2019) highlights the specific case of Lagos, Nigeria, where domestic waste generation is steadily increasing due to economic development, population growth, and changing consumption patterns. Despite efforts by the Lagos State Waste Management Authority, challenges remain. Budget constraints, lack of qualified personnel, infrequent site visits due to logistical issues, and exceeding capacity to manage domestic waste all contribute to inefficient waste management (Olusegun, 2019).

Olateju (2022) emphasizes the importance of project monitoring and control in project management with specific significance of timely and accurate information on project progress [to](#) ensuring alignment with initial plans. Project monitoring (PM) can potentially enhance the performance of Waste Management Companies (WMCs) by improving efficiency, reducing costs, and increasing customer satisfaction. However, empirical evidence on the application and measurement of PM in the context of Solid Waste Management (SWM), particularly in developing countries like Nigeria, is relatively scarce.

This study focuses on the role of project monitoring (PM) in SWM projects within a developing country context. PM includes practices such as regular field visits and project schedule charts to track progress and performance. Project Completion Time refers to the time taken by WMCs to complete their projects, from initiation to completion. Analyzing [Project Completion Time](#) is crucial for evaluating project efficiency and effectiveness. It assesses the ability of WMCs to meet

client expectations, fulfil operational and financial objectives, and ultimately contribute to improved waste management outcomes.

Solid waste management (SWM) presents a critical global issue, particularly in developing countries like Nigeria. Rapid urbanization and population growth have led to a significant surge in waste generation, exceeding the capacity of existing waste management systems (World Bank, 2020). This results in overflowing landfills, environmental pollution, and public health risks (Ezerie et al., 2017).

Despite the seriousness of the issue, current waste management practices in developing countries often struggle to deliver efficient services. Waste Management Companies (WMCs) face various challenges, including inadequate infrastructure, limited funding, and lack of public awareness, which hinder effective waste collection and disposal (Ezerie et al., 2017). Furthermore, existing research on waste management primarily focuses on construction waste, neglecting the unique challenges faced in municipal SWM (Navarro, 2019). This lack of research specific to the SWM sector in developing countries creates a significant knowledge gap.

Project management principles, such as planning, monitoring, and control, offer a potential solution for improving SWM efficiency. These principles can help WMCs optimize their operations, improve resource allocation, and ensure timely project completion. However, there is a scarcity of research investigating the application and impact of project management practices specifically in the context of SWM, particularly in developing countries. Studies on project management in other sectors, like manufacturing or construction, may not be directly applicable due to the distinct characteristics and challenges of SWM (e.g., waste composition, logistical complexities).

One crucial aspect of project management in SWM is Project Completion Time (PCT). PCT reflects the efficiency of WMCs in completing waste collection and disposal projects. However, the relationship between project monitoring (PM) practices (e.g., regular field visits, project schedule charts) and PCT in SWM remains largely unexplored. Understanding this relationship is essential for WMCs to improve their performance and meet client expectations.

This study aims to address the identified knowledge gap by investigating the relationship between solid waste management and project completion time of selected waste companies in Lagos state. Vijayalakshmi's (2020) research delved into modern waste management methods, emphasizing the critical role of efficient strategies in enhancing quality of life through effective waste reduction,

recycling, and re-use. The study employed a combination of case studies and a review of recent technological advancements, particularly focusing on the application of Artificial Intelligence (AI) and Machine Learning (ML) in smart waste management systems. The research highlighted the pressing need for intelligent waste management solutions to address issues such as overflowing trash and their broader environmental impacts. By stressing the importance of recycling and reducing landfill dependence, the study advocated for the adoption of advanced technologies to improve waste management practices. The findings underscored the significant role of technological innovation in developing more sustainable waste management systems that can effectively tackle the challenges posed by urban waste generation.

In their 2021 study, Ann, Zezhou, and Chi-Sun undertook a comprehensive examination of strategies for effective garbage reduction and management within the context of building projects in highly urbanized cities, specifically focusing on Hong Kong. The researchers employed a robust desk research methodology, supplemented by semi-structured interviews and focus group discussions, to gain a thorough understanding of the current waste management practices. This multi-method approach facilitated a nuanced and detailed exploration of the issues at hand, providing valuable insights into the complexities of waste management in rapidly growing urban environments. The primary focus of the study was on developing and refining strategies to effectively manage the increasing volume of construction waste, a significant challenge exacerbated by urban expansion and high-density development. By identifying areas for improvement, the study aimed to contribute to more effective waste reduction and management practices, ultimately enhancing sustainability in highly urbanized settings.

The research conducted by Mukherjee et al. in 2021 offered an in-depth review of modern and intelligent technologies designed for the efficient removal and management of garbage in India. This study utilized a comprehensive review methodology to explore a range of innovative waste management techniques, such as plasma gasification, incineration, and microbial fuel cells. The researchers focused on integrating these advanced technologies and international best practices to address the escalating issues related to waste disposal. The comparative analysis highlighted in the study underscored the potential of these technological advancements to significantly enhance waste management outcomes in India. By examining how these innovations can be applied and adapted to the specific challenges faced by Indian waste management systems, the study provided

a critical assessment of the future prospects for improving waste management efficiency through technological intervention.

In their 2022 analysis, Al-Khatib and Monou examined the efficiency of waste management systems in Middle Eastern cities, with a particular emphasis on the impacts of policy and technology. The study employed a mixed-methods approach, incorporating both quantitative data analysis and qualitative interviews, to evaluate the effectiveness of various waste management policies and technological implementations. The research aimed to identify best practices and challenges specific to the region, providing valuable insights into how policy and technology can be leveraged to improve waste management outcomes. The focus of the study was on offering practical recommendations for policy improvements and technological adaptations, with the goal of enhancing waste management efficiency and effectiveness in Middle Eastern urban contexts.

Chien and Wei's (2023) study explored the significant role of community participation in waste management systems within Taiwan. Utilizing a survey-based methodology, the researchers gathered data on community attitudes and behaviors related to waste disposal and recycling practices. The focus was on understanding the impact of community involvement on the efficiency of waste management systems and the effectiveness of educational programs designed to promote better waste practices. The study highlighted substantial correlations between community engagement and improved waste management outcomes, emphasizing the critical importance of public participation in achieving successful waste management. By demonstrating how active community involvement can lead to more effective waste management practices, the research provided valuable insights into strategies for enhancing public engagement and participation in waste reduction efforts.

In their 2024 examination, Garcia and Hernandez investigated the impact of waste-to-energy (WtE) technologies on solid waste management across various European countries. The study utilized a comparative case study approach to evaluate the performance of different WtE plants, focusing on their efficiency, environmental impact, and economic viability. The primary objective was to understand how WtE technologies can complement traditional waste management methods and contribute to more sustainable waste solutions. The study's findings revealed that while WtE technologies offer significant benefits, their successful implementation requires careful

management to balance environmental and economic considerations. By assessing the effectiveness of WtE technologies in the context of European waste management practices, the research provided important insights into how these technologies can be optimized to support sustainable waste management strategies.

The reviewed studies collectively highlight the diverse approaches and advancements in waste management across different contexts. They underscore the significance of integrating modern technologies, such as AI, ML, and WtE, alongside effective policies and community engagement. Technological innovations and strategic policy improvements play crucial roles in enhancing waste management efficiency and sustainability. The studies also illustrate the importance of tailoring solutions to specific regional and sectoral challenges. Future research and practice should continue to focus on optimizing these technologies and strategies to address the evolving waste management needs and environmental impacts globally.

### **Theoretical Framework**

This study is anchored on the Theory of Constraints (TOC), a management philosophy introduced by Eliyahu M. Goldratt in his seminal work, *The Goal* (1984). TOC posits that every organization faces constraints or bottlenecks that impede its overall performance and productivity. According to TOC, identifying and effectively managing these constraints is crucial for enhancing operational efficiency and achieving organizational goals (Goldratt, 1984; Rahman, 1998).

The relevance of TOC to this study stems from its systematic approach to identifying and addressing constraints, which is essential in project management, especially in the context of waste management projects. TOC employs a five-step focusing process which include identifying, exploiting, subordinating, elevating, and repeating constraints that helps project managers systematically tackle obstacles such as resource shortages, schedule delays, scope creep, and quality issues (Landau, 2021; Zivaljevic, 2019). By applying TOC, this study aims to explore how solid waste management can influence the project completion time (PCT) of waste management companies (WMCs) in Lagos State.

PM practices, including regular site visits and project schedule assessments, play a crucial role in tracking progress and addressing inefficiencies in project execution. PCT, which measures the duration from project initiation to completion, is a vital indicator of project performance and

effectiveness. This study will utilize the TOC framework to examine how project monitoring impacts PCT in the context of waste management, with the objective of improving operational outcomes and meeting customer expectations.

The Theory of Constraints has been extensively validated across various industries such as manufacturing, construction, software development, and healthcare, demonstrating its utility in enhancing efficiency and productivity (Landau, 2021; Rahman, 1998; Zivaljevic, 2019). However, it has also faced critiques regarding challenges in constraint identification, potential sub-optimization, and the need for continuous improvement (Draman & Gosselin, 2002; Jackson, 2009; Rahman, 1998). Despite these criticisms, TOC remains a valuable tool for problem-solving and performance enhancement.

By grounding this study in TOC, the research seeks to contribute to the existing literature on both the Theory of Constraints and project management in the waste management sector. It aims to offer novel insights into how effective project monitoring can mitigate constraints and improve project completion times, thereby advancing the understanding and application of TOC in this critical field.

## Methods

This study utilised a survey research design to investigate the impact of project monitoring on project completion time in chosen waste management companies in Lagos State. The final database comprised quantitative data gathered through surveys to obtain numeric information.

The targeted population includes Waste Managers, Waste Vendors, and Waste collectors from specific companies registered under the Lagos State Ministry of Environment and Water Resources, which oversees the Lagos Waste Management Authority. The companies are Amuleya Nig. Ltd., Krestabol Waste Management Ltd., Soladex Nig. Ltd., Olashams Waste Co., and Sanwa Ent. The companies are selected to represent the five divisions of Lagos State: Ikorodu, Badagry, Ikeja, Lagos Island, and Epe (IBILE). The targeted population comprises 90 Waste Managers, 85 Vendors, and 15 Waste Collectors, totaling 190 respondents.

**Table 1: Population of the study**

S/N	Waste Management Company	Waste Managers	Waste Vendors	Waste Collectors	Total
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1	Amuleya Nig. Ltd.	18	17	3	38
2	Krestabol Waste Management Ltd.	18	17	3	40
3	Soladex Nig. Ltd.	18	17	3	36
4	Olashams Waste Co.	18	17	3	42
5	Sanwa Enterprise	18	17	3	34
TOTAL		90	85	15	190

**Source: Human resource Department, 2024**

The study utilised a stratified random sampling technique to choose firms by selecting them according to the five divisions of Lagos State. The study employed purposive sampling to select the specific type of workers pertinent to the study's focus. Random sampling procedures were utilised to choose the sample from the specified population. The researcher employed Taro-Yamane's (1977) formula to determine the sample size from the population. This is expressed below:

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

Where: N = Population

e = allowable error (%)

1 = a constant value

Given that, N = 190 and e is assumed to be 5%, then sample size is;

$$n = \frac{190}{1+190(0.0025)}$$

$$n = \frac{190}{1.475}$$

$$n = 128.81$$

**Sample size = 129**

was calculated using the formula below

$$= n/N * 129$$

The result was shown in the table 2 below,

**Table 2: Proportional Strata of the sample size**

S/N	Waste Management Company	Waste Managers	Waste Vendors	Waste Collectors	Total
1	Amuleya Nig. Ltd.	12	11	3	26
2	Krestabol Waste Management Ltd.	13	12	2	27
3	Soladex Nig. Ltd.	12	11	2	25

4	Olashams Waste Co.	14	13	3	30
5	Sanwa Enterprise	10	9	2	21
<b>Total</b>		<b>61</b>	<b>56</b>	<b>12</b>	<b>129</b>

**Source: Researcher computation 2024**

The study obtained data from original sources. Primary data was gathered using a structured questionnaire. The statements are closed-ended, allowing the researcher to use scientific procedures to collect data and evaluate hypotheses.

The Cronbach's alpha coefficient was used to test the reliability of the instrument with value given as 0.812.

Cronbach's	
Alpha	N of Items
.812	20

**Source: Field Study, 2024**

## Results

**Table 3: Test of Normality**

Statisti	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	c	Df	Sig.	Statistic	Df	Sig.
FV	.236	124	.832	.474	124	.737
PSC	.144	124	.832	.953	124	.824
TD	.162	124	.837	.951	124	.761

Source: Researcher's computation, 2023

Table 3 displays the results of the Shapiro-Wilk test for normality, which was chosen for this study because the sample size is less than two thousand (2000). The variables in this study are normally distributed due to the significant values (Sig.) being greater than 0.05.

**H<sub>01</sub>: Field Visit does not have significant effect on Timely Delivery.**

**Table 4: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.571 <sup>a</sup>	.326	.267	.52679
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a. Predictors: (Constant), FV

**Table 4**

**ANOVA<sup>a</sup>**

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	21.878	1	21.878	78.836	.000 <sup>b</sup>
Residual	33.301	120	.278		
Total	55.179	121			

a. Dependent Variable: TD

b. Predictors: (Constant), FV

**Table 5**

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	1.189	.255		4.661	.000
FV	.582	.066	.630	8.879	.000

a. Dependent Variable: TD

The model's summary statistics consist of R and R<sup>2</sup>. The value of R = 0.571 represents a strong positive correlation, indicating a moderate link between the variables. The percentage of variance in the dependent variable (Timely Delivery) explained by the independent variable (Field Visit) is displayed in the "R Square" column. The 32.6 percent explainability is a substantial portion.

The regression model can accurately predict the dependent variable, as indicated in the ANOVA table. The significance level of the regression analysis is shown by the sig value. The total outcome variable is predicted by the regression model with statistical significance at p < 0.0000, indicating a value lower than 0.05. (i.e., it is well-suited for the data).

The information in the Coefficients table enables us to assess the importance of the Field visit role in the model and to estimate the Mode of Timely Delivery based on that variable by examining the "Sig." column. We may utilise the information found in the "B" column of the Unstandardized Coefficients column.

$$TD = 1.189 + 0.582 FV$$

**H<sub>02</sub>: Project Schedule Chart does not have significant effect on Timely Delivery.**

**Table 6: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.508 <sup>a</sup>	.258	.252	.96422

a. Predictors: (Constant), PSC

**Table 7**

**ANOVA<sup>a</sup>**

Model	Sum of Squares	Df	Mean Square	F	Sig.
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1	Regression	38.837	1	38.837	41.773	.000 <sup>b</sup>
	Residual	111.566	120	.930		
	Total	150.403	121			

a. Dependent Variable: TD

b. Predictors: (Constant), PSC

**Table 8** **Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1	(Constant)	-.942	.638	-1.475	.143
	PSC	1.022	.158		

a. Dependent Variable: TD

The model summary displays the R and R<sup>2</sup> values. The correlation coefficient (R = 0.508) indicates a moderate level of association between the two variables. The R<sup>2</sup> value, shown in the "R Square" column, indicates the proportion of the total variance in Field Visit that can be explained by the independent variable, Project Schedule Chart. Stating it differently, it is significant that 25.8 percent can be accounted for.

The regression model accurately predicts the dependent variable, as indicated in the ANOVA table. The significance level of the regression analysis is shown by the sig value. The total outcome variable is predicted by the regression model with statistical significance at p < 0.0000, indicating a strong match for the data.

The information in the Coefficients table enables us to assess the statistical significance of the Project Schedule Chart in the model and predict Timely Delivery by examining the "Sig." column. The values in the "B" column of the "Unstandardized Coefficients" table can also be utilised.

$$TD = -0.942 + 1.022 PSC$$

**H<sub>03</sub>: Field Visit and Project Schedule Chart does not have significant impact on Timely Delivery.**

**Table 9** **Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673 <sup>a</sup>	.453	.4	.48406

a. Predictors: (Constant), FV, PSC

**Table 10** **ANOVA<sup>a</sup>**

Model	Sum of Squares	Df	Mean Square	F	Sig.
1      Regression	27.295	2	13.648	58.244	.000 <sup>b</sup>
Residual	27.884	119	.234		
Total	55.179	121			

a. Dependent Variable: TD

b. Predictors (Constant), FV, PSC

**Table 11** **Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1      (Constant)	.102	.326		.315	.753
FV	.376	.074	.407	5.091	.000
PSC	.468	.097	.384	4.808	.000

a. Dependent Variable: TD

The third hypothesis was tested using multiple regression analysis as outlined in the regression model. The dependent variable was Timely Delivery (TD), while the independent variables were Field Visit (FV) and Project Schedule Chart (PSC).

Tables 9, 10, and 11 display the model summary, analysis of variance, and coefficient of determination of the results, respectively. The model summary table (Table 9) indicates a substantial positive link between Field visit and Project Schedule Chart with Timely Delivery ( $R = 0.673$ ). A comprehensive approach to field visits and project schedule charts is more likely to enhance timely delivery. The model demonstrates how Field visit and Project Schedule Chart contribute to the variation in Timely Delivery. The coefficient of determination ( $R^2 = 0.453$ ) indicates that 45.3% of the variation in Timely Delivery can be explained by Field visit and Project Schedule Chart.

Table 10 shows the predictive ability of the regression model for the dependent variable, based on the statistical significance of the model. The p-value of 0.000 indicates that the regression model effectively predicts the outcome variable, making it a suitable match for the data. Field visit ( $\beta_{FV}$

= 0.102, p < 0.00) and Project Schedule Chart ( $\beta_{PSC} = 0.102$ , p < 0.00) have statistically significant coefficients in Table 11, indicating their potential to improve Timely Delivery.

$$\text{Regression Model: TD} = 0.102 + 0.376 \text{ FV} + 0.468 \text{ PSC}$$

## Discussion

This study investigated the impact of field visits (FV) and project schedule charts (PSC) on timely delivery (TD) in waste management companies in Lagos, Nigeria. The findings support the rejection of the null hypothesis (no significant effect) for all three hypotheses, indicating that both field visits and project schedule charts play a significant role in ensuring timely delivery.

The analysis revealed a moderate positive correlation between field visits and timely delivery, with a statistically significant p-value. This suggests that companies conducting regular and thorough field visits experience a higher rate of timely deliveries. This aligns with the Theory of Constraints (Goldratt, 2009), which emphasizes identifying and addressing bottlenecks in a system to optimize performance. Field visits can act as a control mechanism, allowing for proactive identification and resolution of potential issues that could delay deliveries. For instance, field visits can uncover logistical challenges, equipment malfunctions, or communication gaps that could hinder timely waste collection or disposal (Sodhi & Abhishek, 2003). By proactively addressing these issues, companies can ensure a smoother workflow and avoid delays.

Project schedule charts also demonstrated a significant positive correlation with timely delivery. Companies utilizing well-defined project schedule charts are more likely to achieve timely deliveries. Effective project scheduling helps allocate resources efficiently, track progress, and identify potential delays before they occur (Meredith & Mantel, 2009). This aligns with the Theory of Constraints by focusing on removing limitations that could hinder timely delivery. Project schedules provide a clear roadmap for waste management projects, outlining specific tasks, timelines, and dependencies. By visually representing the project plan, companies can identify potential bottlenecks early on and adjust resource allocation or timelines accordingly (Baccarini, 1995).

The strongest correlation was observed when analyzing the combined effect of field visits and project schedule charts on timely delivery. The coefficient of determination indicates that almost half of the variation in timely delivery can be explained by these two factors. Companies that

implement both thorough field visits and well-structured project schedules are most likely to achieve timely deliveries and potentially enhance overall waste management performance by avoiding operational inefficiencies. Timely delivery of waste collection and disposal services is crucial for maintaining public health and environmental sanitation (Sharholy et al., 2008). By implementing proactive measures like field visits and effective project scheduling, waste management companies can ensure efficient service delivery and contribute to a cleaner and healthier environment.

Overall, this study highlights the importance of proactive project management practices, including field visits and project schedule charts, for ensuring timely delivery in waste management companies. By implementing these strategies, companies can not only improve operational efficiency but also contribute to a more sustainable waste management system.

### **Conclusions**

The research results supported the conclusion that doing field visits would significantly improve the promptness of deliveries. Utilising sufficient field visits might expedite project execution if effectively utilised by Waste Management Companies. The research findings supported the conclusion that implementing a Project Schedule Chart would significantly improve timely delivery. Using a proper Project Schedule chart helps accelerate the timely completion of projects when effectively utilised by Waste Management Companies. The research work analysis revealed that field visits and project schedule charts are crucial for timely delivery. The research concluded that Waste Management Companies could utilise thorough field visits and project schedule charts to improve the timeliness of their waste management processes.

### **Recommendation**

Based on the research findings, the study recommended that waste management firms should conduct thorough field visits to guarantee projects are delivered on schedule and to improve waste management performance. Also, waste management businesses should utilise project schedule charts effectively to guarantee projects are delivered on time and to improve the performance of waste management processes. The study also recommends that trash management organisations should utilise field visits and project timeline charts to ensure proper trash disposal and improve the efficiency of waste management processes.

The study created indicators and implemented them in Waste Management based on Project

Management concepts. The study successfully linked the idea of limitations with project completion time, a project management technique. Previous literature available to the researcher indicated that the majority of studies on Waste Management are undertaken outside, with only a small number of scholars within the country having conducted research on this topic. This study could serve as a catalyst for academics with similar interests who aim to address specific challenges in trash management.

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