Project Management Techniques and Performance of Selected Solid Waste Management Companies in Lagos State.

Idris I. Oshin, Rukayat O. Pelumi, Riyanat O. Tiamiyu

Department of Project Management Technology Faculty of Management Sciences, Lagos State University, Lagos, Nigeria

ABSTRACT

Nigeria, like most other developing nations, is experiencing a rapid increase in population with the attendant environmental change which create more centers of daily activities, and the intensity of these centers are of increasing environmental liabilities. Society is currently disposing of tons of waste at designated landfills per day. The sorting facilities are currently saturated, and this is becoming a menace to society. This study seeks to determine the impact of Project Scheduling (PS) and Project Monitoring on the 3Rs of Waste Management. (Reduce, Reuse and Recycle) of some selected waste management companies in Lagos State. Survey research design was adopted for this study. The stratified random sampling technique was employed in selecting 129 staff randomly selected from the population. Data was gotten from primary source by using structured questionnaire. The study considered construct and content validities. To test relevant hypotheses, Multiple Regression analysis was adopted. The study found out that there is a strong positive relationship among Project Scheduling, Project monitoring and the 3Rs of Waste Management (R = 0.703)70.3%; the coefficient of multiple determination (Adj. R2 = 0.486) shows that 48.6% of the change in the 3Rs of Waste Management is accounted for by Project Scheduling and Project Monitoring. This implies that Project Scheduling and Project monitoring has a strong influence on the 3Rs of Waste Management. It was therefore recommended that Proper implementation of the 3Rs of Waste Management should be adopted by Waste Management organisations in other to ensure that Project Scheduling and Project Monitoring are adequately executed in other to enhance the Performance of Waste.

Keyword: Project Management Techniques, Project Scheduling, Project Monitoring, 3Rs of Waste Management.

INTRODUCTION

Most of the developed countries are using advanced management techniques like Germany (Enhanced Resolution, Mobile sorting) that are proving to be very helpful in eluding the waste as well as creating a better probability of recycling and reuse of waste products to make them environmentally friendly. Fan, Li, Wang, Lin, Huang, Yao, & Wu, (2020).

Developing country like India mostly produce inert waste such as dust, sand, stones, etc., and high moisture levels due to the high usage of fresh fruit and vegetables. The composition of the generated waste and its amount directly influences the environment; their waste products management are hindered by their level of technology.

Nigeria, like most other developing nations, is experiencing a rapid increase in population with the attendant environmental change which create more centers of daily activities, and the intensity of these centers are of increasing environmental liabilities. As a result of rapid urbanization combined with industrialization in most of these cities, there are greater concentrations of waste than these cities systems can absorb. (Onuminya & Nze 2018).

According to Olusegun (2019), Domestic waste from communities in Lagos has continuously increased with economic development, population growth, changes in consumption behavior and overuse of natural resources. Local administrations like the Lagos State Waste Management Authority are often trying their best in terms of

local pollution management, limitation of budget, qualified officers and knowledge, and the domestic waste exceeded the management capacity.

This practice has sometimes resulted in the littering of the surroundings, creating eyesore and odor nuisance (Ihuoma, 2012). Lagos, the second fastest growing city in Africa and seventh in the world, generates more than 9,000-10,000 tons of urban waste every day making municipal waste management a big challenge (Vanguard, 2010 and Bakare, 2016).

Audu, (2017), defined waste as simply left-over, or already used items waiting for reuse or disposal. In Nigeria, open dumping of solid wastes into wetlands, watercourses, drains and burrow pit is a prevalent form of disposal.

Effective Project Management Techniques in the Solid Waste Management industry could lead to optimal Waste Management, decreased expenses, and make waste more environmentally friendly. According to Imade, (2023). It includes everything from the equipment and procedures to the expertise needed to complete a Project successfully (Turner, 2016).

In order to successfully manage a project, one must first determine what needs to be done, then outline the goals and outputs of the endeavor, all while keeping in mind the "triple constraint" of time, scope, and cost (Schwalbe, 2015).

Various sectors of the economy have long relied on Project Management Techniques to address challenges, optimize limited resources, and advance critical goals and the same approaches may be utilized effectively in the solid waste management industry. (Kerzner, 2017).

For this study Project Management Techniques would serve as our independent variable which would be measured using Project Scheduling and Project Monitoring (PM).

While Performance of Waste Management would be our dependent variable and it would be measured using the 3Rs of Waste Management which are Waste Reduction, Reuse and Recycle.

Project Management Techniques (PMT) are a set of procedures and activities that can increase the likelihood of success and can be used to better the environment as well as improve performance in terms of cost, time and effective delivery service that contribute to the achievement of the project objectives, in complete harmony and environmental sanity. The goals of Project Management are mostly to create an enabling environment, allocating sufficient resources, mitigating risks, maintaining quality standards, and ensuring effective service delivery (PMI, 2017). Project Management Techniques are used in phases like planning, carrying out, and checking in on a project to make sure that time, effort, and resources are being put where they will be most effective in achieving the desired results (CoEPM2, 2019).

A recent study carried out by Routray (2022), on building sustainable businesses with the 3R (Reduce, Reuse, Recycle) Philosophy Models in the Solid Waste Management Sector in India found out that Exponential surge in inhabitants, high population density of urban areas, diverse cultures, changing food habits, and lifestyle have seen unresolved problems in terms of municipal solid waste especially in economies like India. He further explained that the problems are further compounded by the reduced lifecycle of products in the production of exogenous amounts of commercial waste. The unsorted solid waste at source, social taboo, citizen's attitude, poor assessment, inadequate strategies, unorganized informal sector of waste, and unplanned fiscal and poor implementation of government. He therefore suggested that the government should come up with better and favorable policies and environmental awareness should be carried out in order to encourage citizens to reduce the generation of minimal waste to make the environment conducive for all.

An analysis of the existing studies on Waste Management found that much of the attention had been placed on managing garbage generated during construction rather than in the intercity or municipal settings (Navarro, 2019). Most of these studies are conducted outside Nigeria, some of these studies also focus on health risk due to waste scavenging and environmental factors associated with waste management. He also suggested that there should be harmonization for the treatment of waste products as well as encouragement of reusing waste products

to embrace circular economic policy.

Imade (2023) asserted that society is currently disposing tons of waste at designated landfills per day. The sorting facilities are currently saturated, and it is suggested that Adequate Mode of Waste Disposal should be adopted by Waste Management organizations to ensure that Project Completion Time is adequately met.

Onuminya and Nze (2018), classified solid Waste Management as one of the three major factors affecting health. Despite the presence of public sanitation agency like the Lagos State Waste Management Authority (LAWMA), the environmental condition in cities is far from sanitary. Most areas in Lagos State where there are major markets it is difficult to get people to clean their environments when the heaps of rubbish collected the previous month are yet to be evacuated. The researchers therefore suggested that the government should ensure the regular maintenance of trucks used by LAWMA as well as public education, orientation and awareness programs on waste handling through the mass media while LAWMA should increase the frequency of waste collection in the state to ensure sustainable environment. There is indiscriminate and improper disposal of solid waste on the streets, markets, sewage, flood drainage, streams and undeveloped plots of land rendering some major streets impassable for weeks. The major constraint faced by the Lagos State Waste Management Authority is improper Scheduling and monitoring of Waste disposal as well the 3Rs (Reduce, Reuse, Recycle) of Waste Management. Most households and individuals engage in improper disposal of municipal waste rather than engaging in the 3Rs of waste management. However, the effectiveness of Waste Management is limited by the constraints mentioned above. These constraints have always increased the overhead cost.

Despite the contribution of these researchers, most of these challenges persist. This study therefore wants to fill the gap in literature by carrying out research work on Project Management Techniques Adoption and Organisational Performance of Solid Waste Management in Lagos State, taking Project scheduling and Project Monitoring to measure Project Management Techniques and the 3Rs of Waste Management to measure the Performance of Waste Management.

Project Management Techniques are strategies that help a team optimize its workflow and ensure success, whether that be reduced waste, increased profits or improved customer satisfaction. It allows your team to focus on the work that matters, free from the distractions caused by tasks going off track or budgets spinning out of control. It empowers them to deliver results that actually impact the business's bottom line. (Nikiforova & Bicevska 2020).

Work Breakdown Structures, Gantt Charts, Project Network Diagrams (Critical Path Method and Program Evaluation and Review Method Techniques), Project Completion Time, Project Sensitivity Analysis, Cost Benefit Analysis, Graphical Evaluation and Review Techniques (GERT), Project Software, Project Monitoring, Project Scheduling, Brainstorming, Bidder Conference, Earned Value Management and Project Scope etc. are just some of the tools and techniques for managing projects to achieve a desired outcome, as outlined by Wysocki (2009).

It was decided that Project Scheduling and Project Monitoring would serve as the Project Management Techniques under scrutiny for this research work.

According to Anjay (2019), knowing how to establish a realistic timeline that ensures the team can meet project deadlines is a key skill to develop if you're thinking about pursuing a career as a project manager. Project management schedules allow you to track a project's progress and keep the team informed about tasks to complete. Learning how to construct a successful schedule can help your team stay organised and complete their tasks before the deadline.

Project scheduling is a process that allows you to create a schedule that you can use to keep track of tasks and deadlines within a project. Typically, project schedules come in the form of a calendar or a timeline. While scheduling a project, it's important that you estimate the start and end dates for individual tasks and project phases to make sure the project advances at the desired speed. You can do this by carefully considering different project milestones, activities and deliverables, which may impact task duration, budget and resource allocation. Kailash, (2019).

Establishing a project schedule is important because it allows you to organize all the information that could potentially impact your project's outcomes. By maintaining a centralised data repository of your project plan and giving your team access to it, you improve communication between all relevant parties, including project managers and stakeholders. Breaking projects into individual tasks is essential in the task prioritisation process. By listing all tasks that the team is about to perform, you can easily determine their criticality. Scheduling allows all parties to be on the same page throughout the project's duration, which minimises the risk of conflicts.

Monitoring a Project entails keeping tabs on its development and intervening as required. If you want to keep your project on track and make sure everything is going as planned, you need to implement a system of checks and balances, as described by Siju & Patel (2017). Corrective measures must be put into place if any discrepancy is found. The primary goal is, therefore, to minimize discrepancy. As a result, it includes the strategies, procedures, and guidelines that will guarantee the project's success. To be successful, a system must establish the following policies: Methods for monitoring the progress of a project; specifically, what will be monitored, when, when, and by whom, Determine the policy for identifying and correcting deviations, including when, when, what, and who should be used to enforce restrictions and perform checks.

The purpose of project monitoring is to safeguard the customer's investment in a development over which the client has little to no say. Project tracking is complementary processes. The information gathered via monitoring is a required and sufficient input for comprehensive assessments to be carried out. Agyeya (2021).

According to International labour Organisation (2016), Monitoring is a constant process of gathering and assessing information about a project, and comparing actual versus expected outcomes to determine how successfully the intervention is being implemented. It compares people, programs, and regions using data collected organically during the program (such as participant demographics, enrollment rates, program completion rates, and expenses). There must be a solid monitoring setup in place before any kind of assessment can be made.

The three R's - reduce, reuse and recycle - are three approaches, and the most environmentally preferred. Reducing, reusing and recycling waste helps save landfill space by keeping useful materials out. The three R's – reduce, reuse and recycle all help to cut down on the amount of waste we throw away. They conserve natural resources, landfill space and energy. Plus, the three R's save land and money that communities must use to dispose of waste in landfills. Routray, (2022).

Reducing Waste means to cut back on the amount of trash we generate. Waste reduction is anything that reduces waste by using less material in the first place. Reducing waste can be as simple as using both sides of a sheet of paper, using ceramic mugs instead of disposable cups, or buying in bulk rather than individually packaged items. (Wichai-Utcha, & Chavalparit, 2019).

Reusing Waste means to find new ways to use things that otherwise would have been thrown out. Reuse of waste means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived. Reusing waste saves energy, reduces greenhouse gas emissions that contribute to global climate change. Helps sustain the environment for future generations. Reduces the amount of waste that will need to be recycled or sent to landfills and incinerators. (Wichai-Utcha & Chavalparit 2019).

Recycling Wastes are gathered from various locations, sorted by kind of product, and then put through a recycling process. In the United States, trash from the Baltimore River is collected by robots. Recycling is used as a method of managing building debris in both Malaysia and Hong Kong (Wahi, et.al. 2016). Created a geo-polymer composite out of recycled municipal and construction debris that is both durable and non-toxic to the environment. Recycle means turning something old and useless (like plastic milk jugs) into something new and useful (like picnic benches, playground equipment and recycling bins). (Tang, Tam & Xue, 2020).

In 2002, Koskela and Howell propounded the Transformation theory. They concluded that Critical Pert Method and End Value Management legitimately have global application because of an underlying theory, but that this theory is "implicit and limited," even if it is not explicitly expressed. The three Rs of waste management, Reduce, Reuse, and Recycle are related to the concept of decomposing the total transformation hierarchically into smaller

units, tasks, and minimizing the cost of each task individually, so this theory would be of great benefit to this research work. Koskela's work provides a foundational understanding of how lean principles apply to project efficiency.

Project theory, as envisioned by Koskela and Howell, is a process that considers time, unpredictability, and customers to turn input into outputs, flows, and value production (2002). Many project management theories advocate for a technique called "Work Break down Structure," which involves breaking down a large transformation into a series of smaller ones, each with its own set of work, and a corresponding set of costs (WBS). This research concludes that the efficacy of waste management may be evaluated if this concept is included in the project management methods now in use. The theory focuses primarily on the process through which inputs become outputs. The material flow, composition of transformation, inspection, movement, and waiting of materials are all considered as processes through which the customer's value is produced via the satisfaction of his needs. Koskela's work provides a foundational understanding of how lean principles apply to project efficiency.

Conceptual Model

Independent Variable   **Dependent Variable**
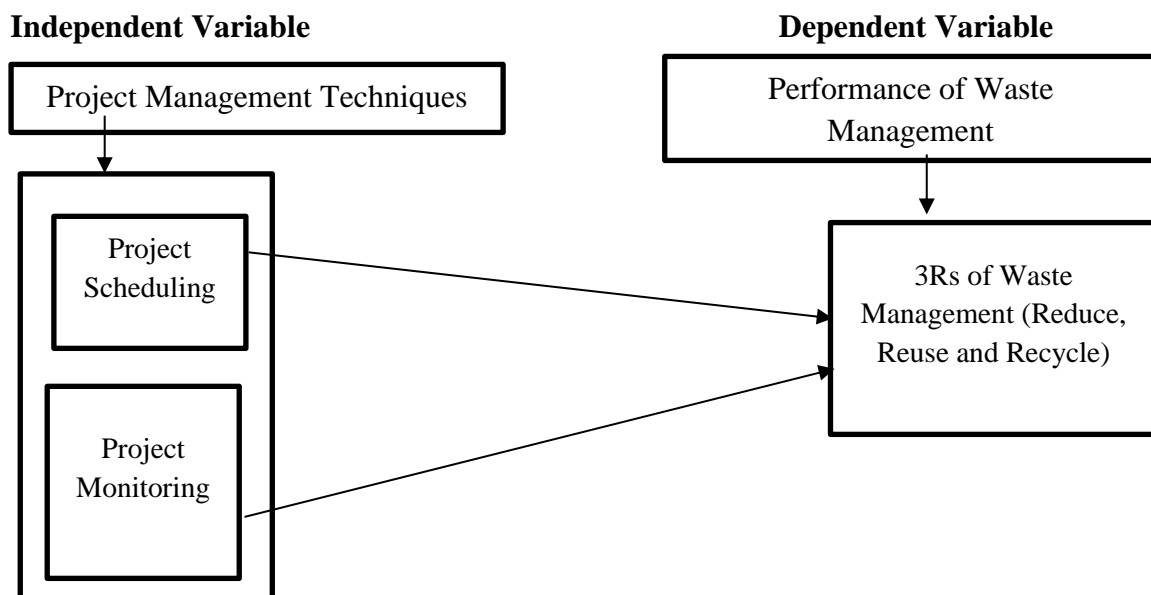
Source: Researcher (2025)

The model above shows that Project Management Techniques is the Independent Variable while Performance of Waste Management is the Dependent Variable for this study. The independent variable is measured with Project Scheduling and Project Monitoring, while the dependent variable is measured with the 3Rs of Waste Management (Reduce, Reuse and Recycle). The arrows show the impact among the variables as stated in the research objectives.

METHODS

The quantitative approach is in the form of Survey research design. The targeted population comprises of Waste Managers, Waste Vendors and Waste collectors of the following companies Amuleya Nig. Ltd., Krestabol Waste Management Ltd., Soladex Nig. Ltd., Olashams Waste Co. and Sanwa Ent. which are registered under the Lagos State Ministry of Environment and Water Resources which houses the Lagos Waste Management Authority. These companies are chosen to cover the five divisions of Lagos State which are Ikorodu, Badagry, Ikeja, Lagos Island and Epe (IBILE) for better representation. The total population for the study consists of 190 individuals, including Waste Managers, Waste Vendors, and Waste Collectors. The distribution of these roles across the selected companies was randomized to reduce sampling bias while keeping the total sample size unchanged. The revised distribution is presented in Table 1.

Table 1: Distribution of Target Population Across Selected Companies

S/N	Company Name	Waste Managers	Waste Vendors	Waste Collectors	Total
1	Olashams Waste Co.	20	13	9	42
2	Krestabol Waste Ltd.	17	19	4	40
3	Soladex Nig. Ltd.	19	14	3	36
4	Sanwa Enterprise	15	14	5	34
5	Amuleya Nig. Ltd.	19	15	4	38
	Total	**90**	**85**	**25**	**190**

Source: Researcher (2025)

This diverse composition enables the study to gather multi-perspective insights from different stakeholders directly involved in solid waste management, enhancing the robustness and generalizability of the findings (Saunders, Lewis, & Thornhill, 2019). By combining managerial, vendor, and collector perspectives, the research aims to capture a comprehensive view of project management techniques and their effects on organisational performance outcomes.

The researcher adopted stratified random sampling techniques to select the choice of firm by selecting them based on the five divisions of Lagos State. The study used purposive sampling techniques to select the category of staff relevant to the course of the study. Lastly, random sampling techniques were used to select the sample from the defined population. The researcher used Taro-Yamane's (1977) formula to determine the sample size of 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

RESULTS

Table 2: Descriptive Statistics for Project Scheduling

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Mean	Standard Deviation
the waste disposal speed is adequate for timing	6.6%	3.3%	6.6%	54.1%	29.5%	3.97	.744

Wastes are properly disposed at the stipulated deadline	6.6%	10.7%	6.6%	66.4%	9.8%	3.62	.823
the organization keep track of waste disposal process	3.3%	10.7%	6.6%	52.5%	27.0%	3.89	1.027
appropriate personnel are put in place for proper timing	3.3%	6.6%	6.6%	46.7%	36.9%	4.07	.997
project timing is properly estimated	3.3%	16.4%	23.0%	37.7%	19.7%	3.54	.884
Grand Total						3.818	0.835

Source: Field Survey (2025)

Table 2 shows that the overall mean for Project Scheduling is 3.818, showing that respondents agreed with most of the high-scaling statements related to Project Scheduling, and that the answers are tightly grouped around the mean. The total standard deviation is 0.835. It's also worth noting that 83.6% were in agreement with the assertions appropriate personnel are put in place proper timing of Project Scheduling.

Table 3: Descriptive Statistics for Project Monitoring

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Mean	Standard Deviation
we have logistics for monitoring our waste products	10.70%	6.60%	6.60%	56.60%	19.70%	3.68	1.18
we employed resources for monitoring our waste products	0.00%	6.60%	13.90%	45.90%	33.60%	4.07	0.86
our waste are divided into deliverables for effective management	3.30%	3.30%	9.80%	70.50%	13.10%	3.87	0.802
we engage in effective communication in monitoring our waste	0.00%	0.00%	6.60%	53.30%	40.20%	4.34	0.598
our waste monitoring system is cost effective	3.30%	0.00%	16.40%	50.00%	30.30%	4.04	0.876
Grand Total						4.00	0.86

Source: Field Survey (2025)

Table 3 shows that the overall mean for Project Monitoring is 4, suggesting that respondents agreed with most of the statements on a wide scale connected to Project Monitoring, and that the responses are concentrated around the mean (standard deviation = 0.86). A whopping 80.30% of respondents said they agreed the organisation's waste monitoring system is cost effective Project Monitoring statements completely.

Table 4 Descriptive Statistics for the 3Rs of Waste Management (Reduce, Reuse and Recycle)

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree	Mean	Standard Deviation
Households are enlightened on how to reduce waste	3.3%	6.6%	6.6%	42.6%	41.0%	4.11	1.014

Waste reduction techniques is easy and simple	19.7%	9.8%	23.0%	26.2%	21.3%	3.20	1.406
Wastes are properly sorted by experts	32.8%	13.1%	20.5%	29.5%	4.1%	4.59	1.322
Waste collectors are well remunerated	4.1%	9.8%	9.8%	69.7%	6.6%	3.65	.899
we engage in recycling of waste product	10.7%	16.4%	6.6%	43.4%	23.0%	4.52	1.300
Grand Total						4.014	1.19

Source: Field Survey (2025)

The grand mean for the 3Rs of Waste Management is 4.014, as shown in Table 4, indicating that respondents agreed with the majority of the statements on the high scale related to the 3Rs of Waste Management, with the overall standard deviation of 1.19 indicating that the responses are somewhat dispersed around the mean. Another interesting fact is that 45.1% of those surveyed did not accept that waste is disposed of via landfills. Sixty-nine-point zero percent also agreed with the assertion that recycling their waste product was an appropriate option of waste disposal.

H01: Project Scheduling and Project Monitoring does not have significant impact on the 3Rs Waste Management.

Table 5 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.703[a]	.495	.486	.48406

a. Predictors: (Constant), PM, PS

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	27.295	2	13.648	58.244	.000b
Residual	27.884	119	0.234		
Total	55.179	129			
a Dependent Variable: **3RsWM**					
b Predictors: (Constant), **PM**, **PS**					

Table 7 Coefficients[a]

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

a. Dependent Variable: 3Rs of Waste Management

To test the hypothesis, multiple regression analysis was used as specified in the regression model. The 3Rs of Waste Management formed the dependent variable and Project Scheduling (PS) and Project Monitoring formed the independent variables. The regression test results are presented in the Table below.

Tables 5, 6 and 7 present the model summary, analysis of variance, and coefficient of determination of the findings, respectively. The model summary table Shows that Project Scheduling and Project Monitoring have strong positive relationship with the 3Rs of Waste Management (R = 0.703). This implies that a holistic approach to Project Scheduling and Project Monitoring is more likely to improve the Performance of Waste Management with the 3Rs of Waste Management. The model further shows the extent to which Project Scheduling and Project Monitoring account for variation in 3Rs of Waste Management. The coefficient of multiple determination (Adj. $R^2 = 0.486$) shows that 48.6% of the change in the 3Rs of Waste Management is accounted for by Project Scheduling and Project Monitoring.

Table 6, Indicates the degree to which the regression model predicts the dependent variable, as indicated by the statistical significance of the regression model. The p-value (0.000) shows that the regression model statistically significantly predicts the outcome variable (i.e., it is a good fit for the data). An evaluation of the standardized coefficients of Project Scheduling and Project Monitoring in the coefficient table (Table 6) and their associated p-values show that Project Scheduling ($\beta PS = 0.102$, $p < 0.00$) and Project Monitoring ($\beta PM = 0.102$, $p < 0.00$) are statistically significant and can be used in enhancing the 3Rs of Waste Management

Regression Model: 3RsWM = 0.102 + 0.407 PS + 0.384 PM

DISCUSSION OF FINDINGS

The findings revealed that Project Scheduling and Project Monitoring contribute significantly to the 3Rs of Waste Management. (R = 0.703; p<0.000), (Adj. $R^2 = 0.486$). Therefore, the null hypothesis was rejected, and the alternative was accepted. This implies that a firm with adequate Project Scheduling and Project Monitoring would more likely promote the 3Rs of Waste Management that could also improve the Performance of Waste Management. The findings of this study is consistent with the research work conducted by Olateju (2017) on Effects of the Application of Project Management Techniques on Healthcare Project Success. The study established that there exists a strong positive relationship between resource allocation and sustainability in Health system. This can further be stressed that Project Management Techniques would improve the performance of waste in the selected Waste Management companies. The three Rs of Waste Management Reduce, Reuse, and Recycle are connected to this finding, as is the Transformation theory, which involves breaking down a large-scale transformation into smaller, more manageable chunks and jobs to reduce the overall cost.

It was indistinct from the research work analysis that Project Management Techniques are vital to the Performance of Waste Management. As a result, the research work concluded that adequate Project Management Techniques should be employed by Waste Management Companies so as to enhance the Performance of their Waste Management processes.

The research findings helped the study to conclude that Project Scheduling and Monitoring would go a long way to enhance the adequate implementation of the 3Rs of Waste Management. It can be further buttress that employing proper implementation of Project Scheduling and Project Monitoring would speed up implementation of the 3Rs of Waste Management if adequately employed by the Waste Management Companies.

Based on the research findings, it was recommended that.

1. Proper implementation of the 3Rs of Waste Management should be adopted by Waste Management organizations to ensure that Project Scheduling and Project Monitoring are adequately executed to enhance the Performance of Waste Management.

Limitations of the Study

This study is geographically constrained by selected waste management firms in Lagos State, limiting its

generalizability. Future studies should consider multi-state analyses and quantitative approaches for broader validation. Additionally, the potential influence of researcher bias was minimized through structured survey design and participant anonymity.

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