



LEAN PROJECT MANAGEMENT AND PERFORMANCE OF ROAD CONSTRUCTION PROJECTS IN NAIROBI CITY COUNTY, KENYA

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ABSTRACT

Lean project management is a strategy applied to improve project performance. The Lean approach in project management focuses on the removal of all forms of waste from projects to allow more efficiency. Despite the significance of the sector to economic development, road projects in Nairobi County have been facing performance challenges. The extent of cost and time overruns in road projects in the Nairobi City County is high. The general objective was to examine effect of lean project management on performance of road construction projects in Nairobi City County, Kenya. The specific objectives were to determine the effect of; value stream mapping, and waste identification on performance of road construction projects in Nairobi City County, Kenya. The study employed a descriptive research design. The unit of analysis was 29 road projects completed in the FY'2022/2023. The unit of observation was 332 project managers, project team members (contractors, quantity surveyors, mechanical engineers, civil engineers, structural engineers, architects and designers, and quality engineers), Lean Project Management experts, quality engineers, contractors/subcontractors, maintenance teams, and government officials from KURA. Yamane 1967 sampling formula was used to sample 181 respondents. The study carried out a pilot test with 18 senior staff involved in management of road construction projects. The study used content and construct validity. Reliability was tested using Cronbach's Alpha Coefficient. Data was analyzed using SPSS Version 28. Descriptive and inferential statistics were used. The descriptive statistics include frequency, percentage, and meanwhile inferential statistics include correlation and regression. Findings were tabulated. The pilot study confirmed the validity and reliability of research instruments for examining the effect of Lean Project Management on road construction projects in Nairobi City County. Findings show that; there is a strong significant relationship between value stream mapping and project performance ($r=0.546$, $p=0.000$), a strong significant relationship between waste identification and project performance ($r=0.814$, $p=0.000$). The study recommends that; the project managers should; consider the flow streams of the construction process hire experts who are knowledgeable on value streams to ensure that projects have suitable value streams, make extra efforts to ensure that material delivery is adequately supervised, and allocate adequate funds for team training.

Key Words: Lean Project Management, Performance, Road Construction Projects, Value Stream Mapping, Waste Identification

Background of the Study

Lean is a project management approach to plan and manage projects more efficiently than the conventional or traditional management technique. This approach is more efficient and reliable on projects which are more complex and on the fast-track construction projects (Tezel & Aziz, 2017). Projects are considered lean projects when they aim to deliver the product while maximizing value and minimizing waste. Lean project management practices help to identify and weed out processes and activities that introduce wasteful spending. The lean approach to project management results in project success, meeting quality, time and costs criteria, and leads to a high level of commitment and motivation from the project team and to the satisfaction of the customer (Anholon & Sano, 2016). Dowson (2021) found that lean project management occupies a unique position in that it makes sense of, interacts, responds to and shapes the systems and processes of both learning and practice responsible for project progress.

According to Oguntona et al. (2018), the most significant benefit of implementing lean practices on a project is the reduction of waste and enhancement of value and the improved life cycle cost of the project. Dahl (2020) explains that large projects both in the private and public sectors are currently implemented under lean practices. It is beneficial to the project owner because of two principles meeting customers' expectations and eliminating waste. The owner or sponsor of the project is assured that all tasks will be completed within a given period as per the expectations and using the predetermined resources.

Statement of the Problem

Road infrastructure is a significant aspect in a country's development both economically and socially. The Kenya Vision 2030 outlines successful road projects as a catalyst for economic development. The government has increased budgetary allocation to the transport sector by from Kshs 184.8 bn in FY'2022/2023 to Sh244 bn in FY'2023/2024 (The National Treasury & Economic Planning, 2024). Road was the leading contributor to the value of transport and storage sector in 2023 accounting for 77.5% of the sector's value output at Kshs 2.2 tn (Economic Survey, 2023).

Despite the significance of the sector to economic development, road projects in Nairobi County have been facing performance challenges. The extent of cost and time overruns in road projects in the Nairobi City County is high. The road projects take longer completion time than expected. In Kenya information held by KeNHA of a few sampled road constructions in Kenya show that road development projects are taking longer than expected to finish (K'Akumu & Gateri, 2022). KURRA (2021) road network survey shows that over 34% of its paved network is still experiencing failures, and more than 50% of its gravel network is poor. The Kenya Urban Roads Authority is facing audit queries about shoddy maintenance work on major city roads. A new audit has disclosed that the entity did not do a good job in the maintenance of Nairobi–Outering Road and a footbridge on Eastern Bypass at the City Cabanas area. A physical verification of the footbridge on Eastern Bypass at the City Cabanas area revealed that the bridge lacked barriers and had no lighting system, questioning whether taxpayers got value for the millions spent on the footbridge. Also flagged was a section of the road in Tassia area which had open drainages clogged with garbage and overgrown vegetation. The accuracy and completeness of the cash and cash equivalents balance of Sh2.7 billion could not be confirmed.

According to KURA (2024), the progress rate of on-going projects in Nairobi County is below 50%. There are many incomplete projects in Nairobi City, County and other counties as well as a result of poor resource mobilization and unavailability of materials, and incompetency of contracting companies. Approximately 55% of the county's road construction projects face various challenges that prohibit them from being completed on schedule, incurring cost overruns, or failing to satisfy quality standards. Kiprop and Yusuf (2022) noted that KURA projects face various challenges which include inflated costs (cost), the slow pace of project

approvals (time), wide range of projects being executed at the same time (scope), credit-worthiness queries by lenders, budgetary restrictions, high unit costs, and escalation. Kenya Roads Board (2021) reported incidents of unused physical and human resources as well as interest on past - due payments resulting to higher expenses

Kigen (2023) added that 26 road projects were inflated to a tune of Sh20 billion. The cost overruns have culminated into a build-up of pending bills, currently estimated at Sh145billion for the road projects alone. Besides increasing the cost of the projects, contractors have also been cited for omitting certain infrastructure without reducing the cost. Odhiambo (2023) discovered that mortar or concrete waste and wood waste has the highest percentage of 22% to 39% and asphalt has about 4% waste. This was mainly due to human error, the use of inadequately trained and unskilled labor.

There exist various studies on project lean management. Issa (2018) found that the application of lean project management helps to lower time and budget overruns. Adamu (2012) found that implementing lean techniques in project management lead to a lot of savings in the project cost. Padayachee (2015) revealed that lean principles can be used to improve project delivery and performance. Mbio (2018) found that lean project management affects project performance in Kirinyaga County. There is however a study limitation on lean project management in the local context. The study hence sought to examine the effect of lean project management and road construction projects in Nairobi City County, Kenya to bridge the research gap.

Research Objectives

- i. To determine effect of project value stream on performance of road construction projects in Nairobi City County, Kenya.
- ii. To determine effect of waste identification on performance of road construction projects in Nairobi City County, Kenya

LITERATURE REVIEW

Theoretical Review

Value Chain Theory

This theory was propounded by Porter in 1985. Porter's value chain is made up of a series of operations that help to develop, create, market, and transport a product. In the core value chain, Porter differentiates between fundamental and support activities. Main activities are logistics, processing, selling and marketing, and services that generate direct value. The supporting activities that help in value creation of products include sourcing, innovations, personnel management, and business facilities (Mathias, 2010). Company operations endeavors are linked to how it manages to record growth in a turbulent operating environment (Nweke, 2017). Understanding the interactions that occur within a value chain helps in pointing out the factors determining the performance of the value chain. Every company participate in its products value creation process although some firms play a greater role in the value chain than other players like the marketers and middlemen (Kothandaraman & Wilson, 2001). An effective value strategy method allows a business to identify the essential competences required to compete, generate and satisfy consumer value anticipations, and manage the value addition process (David, 2011). The theory supports the objective of project value stream. Effective value chain management can help to reduce waste in the construction projects and save project costs and delivery timelines.

Lean Theory

Lean theory was introduced by James, Womack, Jones and Roos (1991). The theory was later developed by Nash, Poling and Ward (2006) who saw it as a systematic approach that aims at enhancing a continuous flow of quality product or service to customers just at the time they

need it. According to the theory, processes that aim at fully satisfying customers' needs should follow prescribed principles while minimizing all forms of loss. According to Ciarniene and Vienazindiene (2012), lean is a functional model comprising of comprehensive techniques which aim at reducing and eliminating wastage when combined in a production process hence making a firm more responsive and flexible to changes in demand. Lean theory capitalizes on a continuous quality delivery to customers based on customers' needs at specific times. By doing so, the production process eliminates waste characterized by unnecessary planning meetings, unnecessary inventories, overproduction, and unnecessary transport and over processing (Rand, 2011).

Organizations aiming at applying lean theory in their production lines should have a strong focus on customers, should be willing to remove production wastes form all production processes on daily routine and must be willing to grow and survive prevailing stiff competition. Firms applying this strategy aim at increasing efficiency while at the same time decreasing waste since they receive goods just when they are needed in the production process. The strategy enables producers to accurately forecast demand. Bautista and Santos (2016) assert that organizations can reduce the amount of working capital due to the reduction in inventory levels. Consequently, the strategy ensures step by step inspection of the production process, hence minimizing wastage. Lean theory forms the basis of this research as it evaluates and brings out lean practices that aim at removing waste in construction projects.

Conceptual Framework

A conceptual framework (Cresswell, 2003) is a graphical representation of the interdependence of variables that depicts a phenomenon inside a process system. Figure 2.1 depicts the conceptualization of the study variables

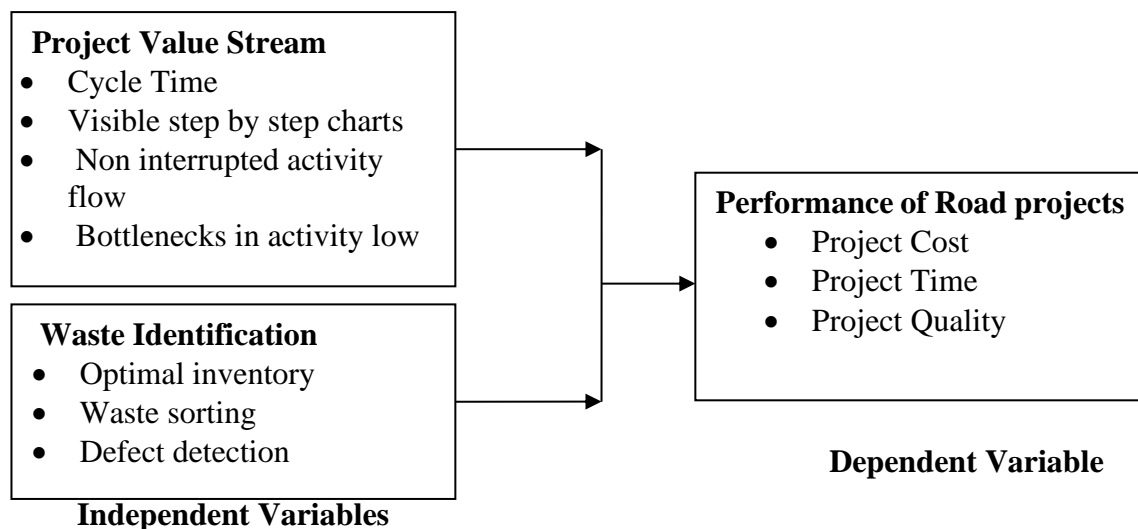


Figure 2. 1: Conceptual Framework

Project Value Stream

Project value stream is a project workflow visualization tool that pictorially represents the events leading to quality project delivery. It looks at the steps to make a product and finds the high-value steps and wasteful areas. It is also forward-looking as the technique can be used to design a production model that will consider current performance and future goals. A value stream is the sequence of activities necessary to deliver a product, service or experience to a customer, internal or external. Value stream map displays all critical steps in a specific process and easily quantifies the time and volume taken at each stage. It shows the flow of both materials and information as they progress through the process.

A short lead-time through a process chain (a value stream) results in a higher output therefore in higher productivity and thus increases the overall added value within this given period (Meudt, 2017). A value stream map that reflects the current state of the process being treated is created then analyzed for waste and value creation, and a future-state map is created, which represents how the process could and should operate. An improvement plan is then generated which enables the transformation from the current state to the future state (Goriwond & Mhlanga, 2020). VSM allows us to visualize the progressive work being developed, aiming at highlighting some of the main wastes in the production system. It provides a pictorial view of existing processes and provides guides to identify gap areas for improvement through the application of Lean concepts.

Waste Identification

Waste is all activities that do not add value to a process and carrying out these activities requires time and money. In the lean principle, all activities that do not provide added value (waste) must be eliminated because doing these activities requires time and money (Mubaslat, 2021). Identifying waste is a continuous process improvement methodology that focuses on identifying and eliminating non-value added or wasteful activities. Waste management is the process of ensuring that a company manufactures environmentally friendly products, and the manufacturing process emits as less waste as possible (Saleena & Ahammed, 2019). Managing waste comprises of treating and elimination of waste materials and their causing output. Analysis of the whole inflow through the assembly of human actions can assist solution of major issues with managing waste. Waste management refer to the idea of preventing, reusing, reducing, recycling or recovering waste (Sivakumaran, 2015). The identification and elimination of waste would trigger intrinsic and instrumental actions to improve both productivity and sustainable performance of projects. Indeed, waste exists inside and outside production systems. Inner production waste is significant and commonly associated to Non-Value-Added works (NVA) which is the utilization of time, space, resources, material, and information without adding value to internal or external customers. Waste identification is conducted using Waste Relationship Matrix (WRM) and Waste Assessment Questionnaire (WAQ). WRM is applied to determine the relationship amongst wastes, while WAQ is used to assess the type of waste and rank the wastes.

Empirical Literature Review

Project Value Stream and Project Performance

Uljas (2020) studied value stream mapping for port projects. The study adopted qualitative research design. Data for this study was collected through literature review. Results showed that value stream mapping and the Scrum-method were used to create a future state map for the docking projects. Communication problems and unstable operating environment caused the greatest challenges to project operations. The future state map methods were used to eliminate problems or reduce their effects significantly. However, the future state map is not a ready model for implementation but provides a direction and base line for the development actions. The visual model provides a base line for the development activities of the project management department.

Melin and Barth (2020) examined effect of value stream mapping in the dairy sector in Sweden. Data were collected through interviewing farmers, workshops, and farm observations. The results revealed that VSM is an effective way to create a culture of collaboration among the farm staff and to better define their roles and responsibilities as well as improve routines, communications, and task completion. VSM adoption resulted to improvements in milk production/quality and animal health. Although lean principles are relevant given the repetitive nature of agriculture routines and tasks, the VSM element of lead-time reduction is less relevant owing to the unique value adding biological processes in the agriculture sector.

Rutherford, Burke, and Cheung (2017) explored the impact of a rural agricultural value chain project in Liberia on smallholder farmers. The study adopted longitudinal field-based quasi-experimental survey data. Mixed methods were used to collect data which included focus groups discussions with farmers, key informant interviews with community leaders, and project monitoring farmer diaries. Findings showed that the use of modern farming techniques improved production, and households experienced greater access to food. Participation in agricultural value chain interventions contributes to positive farm outcomes and social assets.

Ngcongong (2021) sought to identify determinants of smallholder irrigators in the agricultural value chain. The respondents were 243 respondents from two irrigations schemes in South Africa. Results showed seven actors involved in the smallholder irrigators value chain: input suppliers, producers, collectors/hawkers, wholesalers, retailers, consumers, and value chain supporters. Value chain activities that farmers primarily performed were cleaning and sorting. Results indicated that age, livestock ownership, land size, labor, credit access, and exchange of produce significantly influenced the extent of smallholder irrigators' value chain participation. The study's profitability results show a positive result for gross margin, indicating that smallholder irrigators generate sufficient income 'on average' to sustain their livelihoods.

Onyancha and Kimutai (2018) sought to find out the effect of lean project management on performance of building construction firms in Nairobi City County, Kenya. The researcher adopted a descriptive research design. The target was registered construction companies. Data collection was done using questionnaires. Results showed that the value stream was dismally known to many of the firms contacted. The firms incurred overrun costs and rework costs because unnecessary flows in construction were done when they ought to have not. Some firms had the method in place, but it was incomplete in that most lacked experts to visualize the stream and make necessary changes that could make the construction process efficient and effective.

Waste Identification and Project Performance

Rani (2017) analyzed the cause of material waste on projects. This study aimed to find out the dominant factor on the cause of material waste on projects, and to analyze the relationship and the influence between material waste factors and material waste indicators on project. This study used questionnaire distributed to contractors. The population was 209 contractors and 68 contractors. The result study showed that the dominant factor causing the material waste on the project is material procurement factor. There was a relationship between material wastage and performance of programs.

Sulaeman, Sigit, and Sudarmadji (2018) sought to identify the characteristics of solid waste (type, time of occurrence and sources of trash) and its impact on agriculture. The study was conducted in four irrigation areas, namely Gamping, Merdiko, Nglaren and Karangploso in Bantul District, Yogyakarta Special Region. The field instrument was Irrigation Rapid Trash Assessment (IRTA). The results showed that trash was found throughout irrigation canals and rice fields, and the occurrence was influenced by water flow, time and farmer activities. The irrigation was dominantly polluted by plastic trash (52.2%), biodegradable waste (17.91%) and miscellaneous trash (12.3%). The IRTA score showed that Gamping Irrigation Area was at marginal condition, bearing a high risk of disturbing the operation and maintenance of the irrigation canals as well as farmers' health. Trash in irrigation also generated technical impact of the irrigation operation and maintenance, environmental quality, and social life.

Prempeh (2017) studied impact of efficient inventory management on profitability of manufacturing firms in Ghana. A cross sectional data from 2004 to 2014 was gathered for the analysis from the annual reports of four manufacturing firms listed on the Ghana Stock Exchange. The study revealed that raw materials inventory management significantly affects company profitability. Therefore, efficient management of raw material inventory is a major

factor to be considered by Ghanaian manufacturers in enhancing or boosting their profitability. Orechi and Ondara (2022) investigated the effect of inventory management controls on project performance of selected construction companies in Nairobi City County, Kenya. The sample was 206 respondents selected using stratified random sampling technique. Self-administered questionnaires were used to collect primary data. The study found that inventory management controls significantly and positively impact the project performance of the selected construction companies in Nairobi County. The study concluded that through inventory management controls, the construction firms were able to regulate inventory levels by keeping the right amount of each product in stock, monitoring their purchase orders, and maintaining a working supply chain.

Gitau (2018) investigated the influence of construction waste management practices on the performance of housing and water projects in Nairobi City County, Kenya. A descriptive survey research design was used. The sample was comprised of 285 respondents. Questionnaires were used to collect primary data. Results showed that materials handling ensures that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost. Reuse, recycle and reduce practices are vital part in any waste management strategy because they help reduce waste handling and disposal costs, by avoiding the cost of recycling, land filling and combustion.

RESEARCH METHODOLOGY

The study employed a descriptive research design. The study targeted road projects in Nairobi City County. According to the Kenya Urban Roads Authority (KURA, 2024), 29 road projects were implemented in Nairobi County in the FY 2022/2023. Therefore, the unit of analysis encompassed these 29 road projects, while the unit of observation included various personnel involved in implementation of road projects. Therefore, the target population was 332 individuals. Yamane 1967 sampling formula was used to calculate the sample. The sample size for the study was 181 respondents. The study used primary data collected using questionnaires. The study carried out a pilot test with 18 project staff involved in implementation of road projects. Data was analyzed using SPSS Version 28. Descriptive and inferential statistics were used. The descriptive statistics included frequency, percentage, and meanwhile inferential statistics includes correlation and regression.

RESEARCH FINDINGS AND DISCUSSIONS

The study sampled 181 respondents and 18 were used for piloting. Questionnaires were hence administered to 163 respondents and 144 questionnaires were successfully answered. The response rate was 88.3% which good for analysis. as recommended by Kothari (2012) that a response rate which is more than 50% is considered adequate while excellent response rate is usually above 70%. This implies that the response rate in this research is good for making conclusions as well as recommendations. The high response rate was as a result of researchers' efforts to closely monitor the data collection process

Value Stream Mapping

The first objective was to determine effect of project value stream on performance of road construction projects in Nairobi City County, Kenya. Project staff were asked to tick on the extent to which they agree/disagree with statements related to project value stream. Findings are presented in Table 1.

Table 1: Value Stream Mapping

Key: *SD=Strongly disagree, D=Disagree, NS=Not Sure, A=Agree, SA= Strongly agree, M=Mean, Std.=Standard Deviation*

Statements	SD %	D %	N %	A %	SA %	M	Std.
The road projects have value stream maps	10.4	55.6	8.3	4.9	20.8	1.91	1.384
Value Stream mapping helps to identify non-value-adding activities	9.7	8.3	7.6	11.8	62.5	4.10	1.288
Value stream mapping helps to reduce reworks and overruns	13.2	2.1	9.7	29.2	45.8	3.92	1.354
Standard charts are clearly displayed and easily understood	47.9	26.4	9.7	6.3	9.7	2.03	1.308
Flow charts help to understand project activities	9.7	5.6	4.2	35.4	45.1	4.01	1.265
Value stream mapping is done by experts	27.8	39.6	9.7	11.1	11.8	2.57	1.380
Average						3.09	1.330

N=144

The responses indicate that most of the road projects are implemented without value stream maps. The mean for the Likert scale was 1.91 and 1.384 standard deviation showing a disagreement by the project management team on whether the projects had value stream maps. Findings indicate that project workflow is not presented in diagrams or photos hence there may be lack of clarity on the project activities that are to be conducted in every project phase. The respondents strongly agreed that value stream mapping helps to identify non-value-adding activities. This is indicated by a mean of 4.10 and standard deviation of 1.288. In addition, project management professionals agree that value stream mapping reduces reworks and overruns as indicated by a mean of 3.92 and standard deviation 1.354. Findings further show that the project professionals agreed that flow charts help to understand project activities. This is indicated by a mean of 4.01 and standard deviation of 1.265. The findings imply that although value stream maps are not used in majority of the road projects, the project management professionals are aware that the use of value stream helps to identify non-value-adding activities, reduce reworks and overruns, and help project team to understand project activities. Constant reworks increase project funds and times leading to time and budget overruns. The mean for the likert scale on the statement regarding displaying standards charts was 2.03 and 1.308 standard deviation showing that the respondents disagreed that standard charts are not clearly displayed hence not easily understood. Therefore, the project team management may have challenges in understanding the project activities. The respondents indicated that value stream mapping is not done by experts. The mean for the Likert scale was 2.57 and 1.380 standard deviation showing a disagreement by the project management team on whether value stream mapping is done by experts. The average mean for the variable on value stream mapping is 3.09 and standard deviation of 1.330.

This is an indication that respondents agreed with half of items on value stream mapping and disagreed with the other items in almost equal degrees. Findings are in support of Onyancha and Kimutai (2018) that the value stream was dismally known to many construction firms. The firms incurred overrun costs and rework costs because unnecessary flows in construction were done when they ought to have not. Some firms have the method in place, but it was incomplete in that most lacked experts to visualize the stream and make necessary changes that could make the construction process efficient and effective.

Waste Identification

The third objective sought to determine effect of waste identification on performance of road construction projects in Nairobi City County, Kenya. Respondents were asked to tick on the extent to which they agree/disagree with statements related to waste identification. Findings are presented in Table 2.

Table 2: Waste Identification

Key: SD=Strongly disagree, D=Disagree, NS=Not Sure, A=Agree, SA= Strongly agree, M=Mean, Std.=Standard Deviation

Statements	SD %	D %	N %	A %	SA %	M	Std.
There is adequate site access for material delivery and movement	67.4	13.9	2.1	11.1	5.6	2.26	1.257
Waste auditing to monitor and record environmental performance onsite	13.2	5.6	4.2	16.7	60.4	4.06	1.438
There is a dedicated space for sorting of waste	56.3	14.6	4.2	8.3	16.7	1.85	1.560
Waste is minimized through measures taken in materials procurement	14.6	5.6	2.1	33.3	44.4	3.88	1.414
Consideration and prevention of waste through design activities (designing out wastes)	6.3	9.7	3.5	16.0	64.6	4.23	1.261
There is no overstocking in the road projects	3.5	5.6	2.1	13.9	75.0	4.51	1.024
There are fewer defects of the tools and equipment	18.8	59.7	5.6	13.9	2.1	2.08	1.412
Less space is consumed in the warehouses	8.3	9.0	2.1	10.4	70.1	3.95	1.335
Average						3.35	1.337

N=144

The respondents indicated that there is inadequate site access for material delivery and movement. The mean for the Likert scale was 2.26 and 1.257 standard deviation showing a disagreement by the project professionals on whether there is adequate site access for material delivery and movement. The findings implies that project material offloading is not well supervised which may create loopholes for looting of project materials or delivery of less quantity than ordered. This may have an effect on project implementation as the materials may not complete the intended project activity. The findings show that there is waste auditing to monitor and record environmental performance onsite as shown by a mean of 4.06 and standard deviation of 1.438. This is an indication that the project managers carry out audits to determine the effect of project waste on the environment which may guide on adoption of environmental conscious waste management strategies. There is no dedicated space for sorting waste. This is supported by majority of the respondents who disagreed with this statement as shown by a mean of 1.85 and standard deviation of 1.560. This is an indication that the project managers have not set aside a specific area of sorting project waste which is an indication of poor project waste management. Waste sorting may help in recycling and reusing of some project materials. This would help to save on some materials. The project managers agreed that they take measures to minimize waste in procured materials. This is supported by a mean of 3.88 and standard deviation of 1.414. The findings imply that the project managers order the required quantity of materials to avoid procurement wastage. The project managers further consider and prevent waste through design activities (designing out wastes). This is supported by a mean of 4.23 and standard deviation of 1.261 which shows that the respondents agreed with the

statement that there is consideration and prevention of waste through design activities. Findings further show that there is no overstocking in the road projects. This is a mean of 4.51 and standard deviation of 1.024. This has also ensured that less space is consumed in the warehouses as agreed by the respondents. A mean of 3.95 and standard deviation of 1.335 show that the respondents agreed that less space is consumed in the warehouses. This may imply that the project materials are either inadequate or the exact materials needed are ordered. There is hence no overflow of materials for project implementation. The respondents disagreed that there are fewer defects of the tools and equipment. This is indicated by mean of 2.08 and standard deviation of 1.412 which shows that majority of the respondents disagreed with this statement. Findings imply that the tools and equipment used in road construction are prone to breakdown which may delay project implementation.

The average mean of 3.35 and standard deviation of 1.335 shows that majority of the respondents agreed with the statements on waste identification. Results are in support of Orechi and Ondara (2022) that through inventory management controls, the construction firms are able to regulate inventory levels by keeping the right amount of each product in stock, monitoring their purchase orders, and maintaining a working supply chain.

Performance of Road Projects

Respondents were asked to tick on the extent to which they agree/disagree with statements related to performance of road projects in Nairobi County. Findings are presented in Table 3.

Table 3: Performance of Road Projects

Key: SD=Strongly disagree, D=Disagree, NS=Not Sure, A=Agree, SA= Strongly agree, M=Mean, Std.=Standard Deviation

Statements	SD %	D %	N %	A %	SA %	M	Std.
The projects meet time objective	64.6	2.1	9.7	11.8	11.8	2.04	1.514
Projects are implemented within set budget	39.6	14.6	20.1	11.8	13.9	2.46	1.457
Project sponsors are satisfied	14.6	2.1	5.6	10.4	67.4	4.14	1.456
Project realizes its benefits	13.9	5.6	4.2	11.8	64.6	3.92	1.473
Project beneficiaries are satisfied	16.7	4.2	13.9	13.9	51.4	3.79	1.514
Average						3.27	1.482

N=144

Findings show that the projects do not meet time objective. This is as indicated by a mean of 2.04 and standard deviation of 1.514 which shows that respondents disagreed with the statement. This implies that the projects are not delivered with set timelines rather delivered at a later date. Results also show that projects are not implemented within set budget as indicated by a mean of 2.46 and standard deviation of 1.457 which shows that respondents disagreed with the statement. This implies that the projects surpass the planned budget. The project sponsors are satisfied as shown by a mean of 4.14 and standard deviation of 1.456. This shows that respondents agreed that project sponsors are satisfied meaning that anticipated quality of the projects is met. The project further realizes their benefits as shown by a mean of 3.92 and standard deviation of 1.473 which is an indication that respondents agreed that the project benefits are realized. The results show that respondents agreed that project beneficiaries are satisfied as shown by a mean of 3.79 and standard deviation of 1.514. The average mean of 3.27 and standard deviation of 1.482 show that majority of the project professionals agreed with statement on project performance.

Correlation Analysis

Correlation analysis was conducted to establish the strength of relationship between the independent and dependent variable. The significance level for significant relationship was ≤ 0.05 . Correlation results are presented in Table 4.

Table 4: Coefficient of Correlation

Variables		Project performance	Project value stream	Waste identification
Project performance	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	144		
Project value stream	Pearson Correlation	.546**	1	
	Sig. (2-tailed)	.000		
	N	144	144	
Waste identification	Pearson Correlation	.814**	.418	1
	Sig. (2-tailed)	.000	.000	
	N	144	144	144

Correlation is significant at the 0.05 level (2-tailed).

Results show that project value stream has a positive moderate significant correlation with performance of road projects ($r = .546$, $\text{sig} = .000$). This implies that an increase in project value stream has in road projects could lead to an increase in project performance. Findings support Uljas (2020) that value stream mapping creates a future state map for the docking projects.

Waste identification has a positive moderate significant correlation with performance of road projects ($r = .814$, $\text{sig} = .000$). This implies that an increase in waste identification in road projects could lead to an increase in project performance. Results support Rani (2017) that material waste management has a significant impact on project management.

Regression Analysis

Table 5: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Constant/Y Intercept	3.127	.318		9.837	.000
Project value stream	.384	.049	.290	6.876	.000
Waste identification	.700	.048	.629	14.571	.000

Waste identification show a statistically significant positive coefficient ($\beta = .700$, $\text{sig} = .000$), indicating that improvements in Waste identification result to higher performance of road projects. Waste identification has the highest effect on project performance at 62.9% (std Beta = .629). Project value stream show a statistically significant positive coefficient ($\beta = .384$, $\text{sig} = .000$), indicating that improvements in project value stream result to higher performance o road projects. Project value stream has the second highest effect on project performance at 29% (std Beta = .290). The finding shows that project value stream is essential in enhancing project performance.

The regression results concur with Issa (2018) that the application of lean project management helps to lower time and budget overruns. Adamu (2012) found that implementing lean techniques in project management lead to a lot of savings in the project cost. Mbio (2018) found that lean project management affects project performance in Kirinyaga County.

Conclusion

Value stream mapping has a strong significant effect on project performance. On value stream mapping and performance, value stream, a visualization technique, is rarely applied in implementation of the road projects. This means that the project financiers could incur overrun costs and rework costs due to the fact that unnecessary flows in construction were done when they ought to have not.

Waste identification has a moderate significant effect on project performance. Waste minimization programs are not well implemented in the road construction projects in Nairobi City County. The researcher hence concludes that there is need for suitable method of waste management to avoid or reduce wastage of project resources. The controlling of material waste quantity can be conducted through recycling material to become useful items.

Recommendations

The road authority need to consider the flow streams of the construction process. This should be done by mapping the process and identifying processes that do not add value to the construction, or including the process that are critical but left out. This essentially should be done by experts or if the firms are not able to hire experts, then trainings to be in place for the employees of the firm to know how visual mapping is done. By having the stream maps, a lot of value will be added in the construction process that brings efficiency in the process and making it cost effective. The project management should ensure that the projects have value stream maps. This will be assured through ensuring that all the project activities are presented diagrammatically and displayed in central points where they can be accessed by the project team. The project managers should also hire experts who are knowledgeable on value streams to ensure that projects have suitable value streams.

The project managers should make extra efforts to ensure that material delivery is adequately supervised. This will ensure that the right quantity is delivered and the close supervision will prevent chances of looting project materials. The site managers should also ensure that there is a dedicated space for sorting waste. This will ensure suitable waste managements and also reduce workplace accidents. Some of the sorted materials could also be recycled and reused in other project activities hence saving project costs.

Areas for Further Study

A similar study on lean management in road projects in other counties in Kenya. A study could also be conducted on lean project management on road implemented by other road agencies like KENHA, KERRA or roads funded through PPP models. The study shows that the lean project management practices studied contribute to 79.9% on performance of road projects in Nairobi County, Kenya. A further study is recommended to establish the other lean project management practices that contribute to 20.1% of performance of road projects in Nairobi County in Nairobi County, Kenya.

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