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Factors Influencing Adoption and Successful Implementation of Value Stream Mapping in Building Project Management

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ABSTRACT

This study investigated the factors influencing the use of Value Stream Mapping (VSM) and the elements that support its successful integration in building construction project management. It adopted a quantitative research approach, with some qualitative insights from open-ended questionnaire responses. Data were gathered via a structured questionnaire administered to construction professionals managing and executing projects in Lagos State. The analysis included descriptive statistics, Relative Importance Index, Pearson correlation, multiple regression, and ANOVA. Results showed that Management Support and Team Collaboration (Mean = 4.40) and Data Availability and Accuracy (Mean = 4.32) were the most significant factors influencing VSM application, with an overall mean of 3.95. The one-sample t-test ($t(279) = 22.72$, $p < 0.001$) confirmed the significant impact of these factors. For effective adoption, Strong Management Commitment (Mean = 4.55), Training and Skill Development (Mean = 4.42), and Lean Construction Awareness and Culture (Mean = 4.35) were the top factors, with an overall mean of 4.18. The t-test ($t(279) = 30.41$, $p < 0.001$) verified their critical importance. The study concludes that VSM implementation mainly presents socio-technical and organizational challenges, requiring management support, skilled personnel, reliable data, collaboration, and ongoing improvement.

KEYWORDS: *Value Stream Mapping, Lean Construction, Building Construction Projects, Management Support, Data Availability and Accuracy, Management Commitment.*

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1. INTRODUCTION

The Nigerian construction industry faces ongoing challenges such as inefficiencies, delays, cost overruns, material waste, low labor productivity, poor activity coordination, and limited use of digital technologies, all of which hinder project success and sector growth (Akanni & Mayowa, 2025; Naser et al., 2023; Akinradewo et al., 2021; Lisseth et al., 2021). While building projects boost employment, housing, and facilities, they struggle with inefficient workflows, poor coordination, and weak management of materials and information (Lisseth et al., 2021). This situation highlights the need for structured improvements that reduce waste, boost productivity, and increase value. Lean construction, adapted from manufacturing principles, offers a way to enhance efficiency by optimizing processes and eliminating waste (Nur Sabrina et al., 2024; Martin et al., 2019). One key tool is Value Stream Mapping (VSM), which visually analyzes material and information flows to identify waste and plan improvements (Oyewobi et al., 2024; Akinradewo et al., 2021). Originally from Toyota's production system, VSM has been adapted for construction to address workflow fragmentation, multiple stakeholders, and process variability (Lisseth et al., 2021; Murat & Ayman, 2019; Nur Sabrina et al., 2024).

In construction, VSM helps assess material supply, information exchange, labor processes, workflow sequences, planning, scheduling, and site coordination. Visualizing these processes enables managers to distinguish value-adding from non-value activities, reducing delays, rework, and improving coordination and productivity (Oyewobi et al., 2024;

Akinradewo et al., 2021). VSM's relevance is especially critical in Lagos State, Nigeria's commercial hub and most urbanized area, where diverse and large projects are common. The complexity and scale of these projects, combined with the demand for timely, cost-effective delivery, call for improved management approaches (Oyewobi et al., 2024). Yet, current practices are often fragmented, reactive, and lack systematic process improvements (Ramani & Ksd, 2019). This results in persistent schedule delays, cost increases, waste, rework, and low productivity. Traditional management emphasizes controlling isolated tasks rather than optimizing the whole project, allowing wasteful activities like waiting, unnecessary movement, duplication, and poor communication to persist (Naser et al., 2023; Oyewobi et al., 2024).

Despite its potential, the adoption of VSM remains limited in Nigeria's construction sector, particularly in Lagos State, and there is a lack of empirical research on how construction professionals are aware of, utilize, and benefit from it. Factors influencing VSM use, including organizational readiness, professional skills, project specifics, management support, data, and technology, are not well understood locally. Resistance to change, lack of training, and institutional support are also underreported issues (Akinradewo et al., 2021; Naser et al., 2023). This lack of evidence hampers the ability of practitioners and policymakers to make informed decisions. Successful VSM adoption depends on more than awareness; it requires a supportive organizational environment with committed management, skilled professionals, stakeholder collaboration, and access to data and technology. Understanding these factors is crucial, particularly in contexts where fragmented supply chains and traditional practices prevail. Research in this area can help improve workflow, reduce waste, optimize material and info flow, and enhance project outcomes. It can also address the gap in Nigerian lean construction research by providing context-specific insights into VSM use in building projects. This study aims to identify the key factors affecting VSM adoption and implementation in Lagos's building projects, offering empirical evidence to support better project management and decision-making.

2. LITERATURE REVIEW

2.1. Value Stream Mapping: Concept and Theoretical Basis

2.1.1. Concept of Value Stream Mapping

Value Stream Mapping (VSM) is a lean management tool used to visually represent the flow of materials, information, and activities required to deliver a product or service to the end user. The primary objective of VSM is to distinguish between value-adding activities, non-value-adding activities, and necessary but non-value-adding activities, to eliminate waste and improve overall process efficiency (Naser *et al.,* 2023).

A value stream encompasses all actions both direct and indirect needed to transform raw inputs into a finished output that meets client requirements (Ramani & Ksd, 2019). VSM captures this entire process in a single visual map, allowing organizations to identify bottlenecks, delays, redundancies, and inefficiencies that are often overlooked when processes are examined in isolation. The technique typically involves the development of a current-state map, which represents existing processes, and a future-state map, which proposes improved workflows with reduced waste and enhanced value delivery (Leart, 2019).

Although VSM originated in manufacturing, its principles have been successfully adapted to the service and construction industries (Nur Sabrina et al., 2024). In construction, VSM focuses on mapping workflows such as material supply, information exchange, labour deployment, and sequencing of site activities, with these flows, construction managers can better understand how value is created and where inefficiencies occur across the project lifecycle (Leart, 2019). The construction industry is widely recognized for its complexity, fragmented processes, and persistent challenges such as cost overruns, time delays, low productivity, and material waste. In response to these inefficiencies, lean management principles have gained increasing attention as effective strategies for improving construction performance (Murat & Ayman, 2019).

2.2. Level of Awareness of Value Stream Mapping among Construction Professionals

The level of awareness and practical use of Value Stream Mapping (VSM) among construction professionals has been widely discussed in lean construction literature. Although lean construction principles are increasingly recognized globally, empirical evidence suggests that awareness and application of VSM as a specific lean tool remain limited, particularly in developing construction contexts such as Nigeria and Lagos State (Oyewobi *et al.,* 2024).

2.2.1. Awareness of Value Stream Mapping among Construction Professionals

Studies across different regions indicate that general awareness of lean construction concepts exists, but specific knowledge of VSM is often low. For instance, a survey of lean construction practices in Morocco revealed that approximately 58% of

construction professionals were unfamiliar with Value Stream Mapping, despite being aware of other lean tools (Naser *et al*., 2023). This suggests that VSM is less understood compared to more commonly referenced lean concepts.

In the Nigerian construction industry, awareness of VSM is relatively higher than some developing countries but remains moderate rather than comprehensive. Empirical studies involving architects, engineers, builders, quantity surveyors, and project managers indicate that while many professionals have heard of VSM often through academic training or professional workshops their understanding of how to apply it in real construction settings is limited (Md Rahamat *et al*., 2024; Naser *et al*., 2023). This situation is particularly evident in Lagos State, where construction activities are intense and fast paced, and leaving little room for experimentation with unfamiliar management tools. This pattern aligns with global findings that professionals often possess conceptual awareness without operational competence. That is, VSM is recognized as part of lean construction vocabulary, but its practical implementation remains poorly understood (Md Rahamat *et al*., 2024).

2.2.2. Actual Use of Value Stream Mapping in Construction Practice

Despite increasing awareness, actual use of VSM on construction sites remains limited. Empirical studies consistently show that VSM is rarely integrated into routine construction management practices and is instead applied selectively in pilot studies, academic research, or isolated improvement initiatives (Leart, 2019).

In Lagos State, the use of VSM is constrained by several contextual factors. These include limited formal training in lean tools, the temporary and non-repetitive nature of building projects, fragmented communication structures, and the dominance of traditional project management approaches. Construction firms often rely on conventional scheduling and supervision methods, which limits the adoption of process-oriented tools such as VSM (Oyewobi *et al*., 2024).

Where VSM has been applied in construction projects globally, it is often used to analyze specific workflows rather than entire project systems. For example, international case studies from Qatar, Peru, and India demonstrate that VSM has been successfully applied to discrete construction activities such as deep utilities installation, basement construction, and reinforced concrete slab preparation. These studies show measurable improvements in workflow reliability, cycle time reduction, waste elimination, and quality enhancement (Martin *et al*., 2019). However, such applications remain exceptions rather than standard practice, particularly in developing construction markets.

2.2.3. Barriers Limiting the Use of VSM

Several barriers explain the low level of VSM use despite growing awareness. One of the most critical barriers is the lack of expertise and formal training. Many construction professionals lack the technical skills required to develop, analyze, and implement value stream maps effectively (Murat & Ayman, 2019).

Resistance to change is another significant factor. The construction industry, including that of Lagos State, is traditionally conservative, with firms often reluctant to adopt new management approaches that increase transparency and expose inefficiencies (Oyewobi *et al*., 2024). Additionally, the complexity and variability of construction workflows, which differ from the repetitive processes of manufacturing, make standardization and mapping more challenging. These barriers collectively reduce both the frequency and depth of VSM application, even in contexts where awareness has been established.

2.2.4. Awareness and Use across Professional Roles

The level of awareness and use of VSM also varies across professional roles. Studies indicate that senior managers and project leaders are more likely to be aware of VSM concepts, often through professional development programmes or exposure to lean construction initiatives. In contrast, site supervisors and field personnel typically have limited exposure unless they receive targeted training (Leart, 2019).

Design and planning professionals may apply VSM during pre-construction phases, particularly in analyzing design and information flows. However, the translation of such applications to on-site production processes remains limited. In Lagos State, this disparity is exacerbated by skill gaps and weak integration between planning teams and site operations (Murat & Ayman, 2019).

2.3. Application Areas of Value Stream Mapping in the Management of Building Projects

Value Stream Mapping (VSM) is a core lean management tool used to analyze, improve, and control the flow of materials and information across the construction project lifecycle. Originally developed within the Toyota Production System, VSM has been adapted for construction to address inefficiencies associated with fragmented workflows, multiple stakeholders, and process variability (Lisseth

et al., 2021). In the context of building projects in Lagos State that characterized by high project density, tight schedules, supply chain uncertainties, and labor-intensive operations. VSM offers significant opportunities for improving construction management practices.

2.3.1. Identifying Waste in Construction Processes

One of the most prominent uses of Value Stream Mapping in construction management is the identification and elimination of waste on. Construction sites in Lagos State commonly experience non–value-adding activities such as waiting for materials due to traffic congestion and logistics delays, idle labour and equipment, rework caused by design inconsistencies, excessive material handling on congested sites, and premature execution of work (Naser *et al.*, 2023; Murat & Ayman, 2019). VSM makes these inefficiencies visible and enables project managers to systematically eliminate waste, thereby reducing project costs and improving operational efficiency (Murat & Ayman, 2019).

2.3.2. Improving Workflow and Process Flow

Another critical area of VSM application is the improvement of workflow and process continuity. Construction projects in Lagos often suffer from stop-start work patterns resulting from poor coordination among trades, unreliable planning, and frequent interruptions caused by resource constraints. VSM helps visualize work sequences, identify bottlenecks, balance workloads between trades, and improve continuity of operations. Improved workflow reliability leads to smoother execution and faster project delivery, which is particularly important in Lagos where time overruns have significant financial implications (Naser *et al.*, 2023; Murat & Ayman, 2019).

2.3.3. Reducing Project Delays

Value Stream Mapping is also widely used to reduce project delays by identifying time-related inefficiencies across the project lifecycle. In Lagos State, delays often arise from prolonged approval processes, inspection hold points, late material deliveries, and waiting periods between subcontractor activities. VSM highlights these sources of delay and supports the development of targeted improvement strategies that shorten project duration and enhance schedule performance (Leart, 2019).

2.3.4. Enhancing Coordination among Stakeholders

VSM plays a significant role in enhancing coordination among construction stakeholders. The Lagos construction industry is highly fragmented, involving clients, consultants, main contractors, subcontractors, and suppliers operating under separate contractual arrangements. VSM integrates both material flow and information flow, thereby improving communication between designers and contractors, coordination among subcontractors, and alignment between site operations and procurement activities. Enhanced coordination reduces misunderstandings, disputes, and rework, which are common challenges in urban construction projects (Martin *et al.,* 2019).

2.3.5. Optimizing Material Delivery and Inventory

Another important application of VSM in Lagos-based building projects is the optimization of material delivery and inventory management. Due to limited site space and heavy urban congestion, construction sites in Lagos often experience either excessive material accumulation, leading to congestion and double handling, or material shortages that result in work stoppages. VSM supports just-in-time material delivery planning by aligning supply with actual site demand, thereby reducing storage needs, minimizing waste, and improving site organization (Akinradewo *et al*., 2020).

2.3.6. Improving Labour Productivity

Value Stream Mapping is also used to improve labour productivity, which remains a major concern in the Nigerian construction industry. By analyzing task durations, waiting times, and movement patterns, VSM helps identify idle time, inefficient crew deployment, and unnecessary movement on site. Improved crew allocation and increased value-adding work time enhance labour productivity and overall project efficiency, which is particularly relevant in Lagos, where labour costs and availability significantly influence project performance (Martin *et al.,* 2019).

2.3.7. Supporting Lean Construction Implementation

VSM supports the implementation of Lean Construction principles in building project management. As a foundational lean tool, VSM facilitates continuous improvement, pull-based planning systems, and systematic waste reduction strategies. In Lagos State, where traditional construction management practices dominate, VSM provides a practical entry point for transitioning toward lean-oriented project delivery systems (Naser *et al.*, 2023).

2.3.8. Better Planning and Scheduling

Value Stream Mapping also contributes to improved planning and scheduling of construction activities. Data generated from VSM analysis enables planners to develop more realistic schedules, identify critical

process constraints, and improve work sequencing. This results in more reliable project plans and improved predictability of outcomes, which are essential for managing complex urban construction projects in Lagos (Murat & Ayman, 2019).

2.3.9. Reducing Rework and Quality Problems

Another key use of VSM is in reducing rework and improving quality performance. Rework is a common issue in Lagos building projects due to design changes, poor workmanship, and inadequate inspection regimes. By mapping defect-prone processes and identifying weak inspection points, VSM supports early error detection and prevention, leading to reduced rework, lower project costs, and shorter timelines (Leart, 2019).

2.3.10. Improving Overall Project Performance

Overall, the combined application of Value Stream Mapping leads to improved project performance. When workflow reliability improves and waste is reduced, VSM contributes to lower construction costs, shorter completion times, better resource utilization, and higher client satisfaction (Leart, 2019). These benefits demonstrate the relevance and suitability of Value Stream Mapping as a management tool for improving the delivery of building projects in Lagos State.

2.4. Factors Influencing the Use of Value Stream Mapping in the Management of Building Construction Projects

Construction projects are inherently temporary, variable, and site-based, which significantly influences how management tools such as Value Stream Mapping (VSM) can be applied. Unlike manufacturing environments characterized by repetitive and stable processes, building construction projects particularly in dense urban settings such as Lagos State are subject to changing site conditions, multiple stakeholders, and dynamic workflows. These characteristics shape the extent to which VSM can be effectively used in construction project management (Md Rahamat *et al*., 2024).

2.4.1. Nature of Construction Projects

One of the most fundamental factors influencing the use of VSM is the nature of construction projects. Construction activities are project-based rather than repetitive, with each project differing in design requirements, site constraints, client expectations, and regulatory conditions. Work environments evolve continuously as projects progress, and activities are often non-linear and highly interdependent. In Lagos State, where construction sites are frequently constrained by limited space, traffic congestion, and environmental conditions, this variability makes it difficult to map and standardize value streams in the same manner as manufacturing processes (Md Rahamat *et al*., 2024).

2.4.2. Level of Process Standardization

Closely related to project nature is the level of process standardization within construction firms. Value Stream Mapping is most effective where work processes are repeatable, well-documented, and clearly defined. Organizations that employ standard work methods, checklists, and formal procedures are better positioned to apply VSM successfully. Conversely, poorly documented or informal work practices—common in many Nigerian construction firms—make value stream mapping difficult and less reliable. The higher the degree of workflow standardization, the more meaningful and actionable VSM outputs become (Akinradewo *et al*., 2020).

2.4.3. Data Availability and Accuracy

Another critical factor influencing VSM use is data availability and accuracy. VSM relies on accurate performance data, including cycle times, waiting times, material delivery durations, rework rates, and labour productivity. In many construction projects in Lagos State, such data are either inconsistently recorded or based on estimates rather than direct measurement. Without reliable data, value stream maps risk becoming subjective representations rather than effective analytical tools for process improvement (Yingnan *et al*., 2025).

2.4.4. Complexity of Stakeholder Coordination

The complexity of stakeholder coordination also significantly affects the use of VSM in construction management. Building projects involve multiple independent stakeholders, including clients, consultants, contractors, subcontractors, and suppliers, each with distinct objectives, schedules, and contractual obligations. VSM requires the mapping of both material and information flows, which becomes challenging when communication is fragmented and collaboration is weak. In Lagos State, where project delivery structures are often fragmented, coordinating these flows presents a major constraint to effective VSM implementation (Akinradewo *et al*, 2021).

2.4.5. Supply Chain Reliability

Supply chain reliability is another influential factor. Material flow in construction is highly sensitive to late deliveries, supplier inefficiencies, transportation challenges, and limited storage capacity on site. These issues are particularly pronounced in Lagos due to traffic congestion, logistics bottlenecks, and dependence on external suppliers. An unstable supply chain results in frequent interruptions to the value stream, increasing waiting time and waste, and

reducing the effectiveness of VSM-based improvements (Akinradewo *et al.,* 2020).

2.4.6. Worksite Layout and Physical Constraints

The physical layout and spatial constraints of construction sites further influence VSM use. Unlike factories with fixed layouts, construction sites are temporary and continually evolving. Material movement paths change as work progresses, and space limitations often lead to excessive handling and unnecessary movement. In congested urban sites common in Lagos State, these physical constraints significantly affect material flow and limit the extent to which VSM recommendations can be implemented without complementary site planning strategies (Leart, 2019).

2.4.7. Level of Lean Construction Awareness

Another important factor is the level of lean construction awareness and culture within organizations. As a lean tool, VSM requires management commitment to lean principles, worker understanding of waste reduction, and a culture that supports continuous improvement. Where VSM is perceived merely as additional paperwork rather than a problem-solving tool, its adoption and sustained use are limited. Studies in Nigeria indicate that insufficient lean awareness and weak improvement culture reduce the effectiveness of lean tools, including VSM (Akinradewo *et al.,* 2020

2.4.8. Planning and Scheduling System

The planning and scheduling system adopted by a project also influences the applicability of VSM. Projects that utilize advanced planning approaches, such as the Last Planner System, are more compatible with VSM because work is broken into clearly defined tasks, constraints are identified early, and workflow reliability is actively monitored. In contrast, poor scheduling practices result in frequent disruptions, making value streams unstable and difficult to analyze effectively (Yingnan *et al*., 2025).

2.4.9. Level of Technology Adoption

The level of technology adoption plays a significant role in enabling or constraining VSM use. Digital tools such as Building Information Modelling (BIM), project management software, and material tracking technologies enhance VSM by improving data accuracy, process visualization, and real-time monitoring. In many Lagos-based construction firms, low levels of technology adoption limit data collection and analysis, thereby reducing the effectiveness of VSM implementation (Akinradewo *et al*., 2020).

2.4.10. Management Support and Team Collaboration

Management support and team collaboration are critical determinants of successful VSM use. Value Stream Mapping requires cross-functional participation involving site managers, engineers, procurement teams, supervisors, and workers. Without strong management support to allocate time and resources for mapping and improvement activities, VSM often becomes a one-time exercise with minimal impact. In the Lagos construction context, competing project pressures and short-term performance focus often undermine sustained collaborative improvement initiatives (Yingnan *et al*., 2025).

The use of Value Stream Mapping in the management of building projects is influenced by a combination of project-related, organizational, and contextual factors. These include the nature of construction projects, process standardization, data availability, stakeholder coordination, supply chain reliability, site constraints, lean awareness, planning systems, technology adoption, and management support. In Lagos State, where construction projects are complex and resource-constrained, understanding these influencing factors is essential for developing effective strategies to support the adoption and sustained use of VSM.

Table 1: Factors Influencing Adoption of Value Stream Mapping in Construction

SN	Category (Framework Link)	Specific Factors Identified	Key Authors / Sources
1	Lean culture and awareness (Independent Variable)	Knowledge of lean principles, familiarity with VSM tools, professional exposure	(Martin *et al*., 2019)
2	Training & Capacity Building (Independent Variable)	Availability of lean training, continuous professional development, technical competence	Akinradewo *et al.,* (2021); Leart, (2019)
3	Management Support (Mediating Variable)	Top management commitment, leadership support, allocation of resources	Akinradewo *et al.,* (2021); Oyewobi et al. (2024)
4	Organisational Culture (Moderating Variable)	Openness to innovation, teamwork, continuous improvement culture	Oyewobi *et al*., (2024); Leart, (2019)
5	Project uniqueness and variability (Moderating Variable)	Project size, complexity, procurement method, stakeholder integration	Akinradewo *et al*., (2020)

6	Resistance to Change & Level of Technology Adoption (Independent Variable)	Fear of new systems, attachment to traditional practices	Md Rahamat *et al*., (2024); Oyewobi *et al*., (2024)
7	Process Integration & Communication (Independent Variable)	Fragmented workflows, communication gaps, language barriers	Akinradewo *et al.,* (2021); Leart, (2019)
8	Stakeholder coordination complexity (Independent Variable)	Role of professional bodies, policy frameworks, industry guidance	Md Rahamat *et al*., (2024); Naser *et al.*, (2023)

Sources: Compilations by the Researcher (2026)

2.5. Enabling Factors Supporting Successful Adoption of Value Stream Mapping in Building Construction Projects

The successful adoption of Value Stream Mapping (VSM) in construction management does not occur automatically; rather, it depends on a combination of organizational, technical, and cultural enabling factors (Ramani & Ksd, 2019). In the context of building construction projects—particularly within Lagos State, where projects are complex, fast-paced, and resource-constrained—these enabling conditions are critical for transforming VSM from a theoretical concept into a practical management tool (Ramani & Ksd, 2019).

2.5.1. Strong Management Commitment

A fundamental enabler of VSM adoption is strong management commitment. Successful implementation begins with leadership support for lean thinking and process improvement. Management must allocate time for value stream mapping workshops, support continuous improvement activities, and provide necessary resources such as training, facilitation, and analytical tools. Without top-management commitment, VSM initiatives often become one-time exercises with no sustained impact. In Lagos-based construction firms, competing project pressures and short-term performance focus frequently undermine long-term improvement efforts, making leadership support particularly crucial (Akinradewo *et al.,* 2021).

2.5.2. Lean Construction Awareness and Culture

Closely related to management commitment is the presence of lean construction awareness and a supportive organizational culture. As a core lean tool, VSM requires an understanding of the concepts of value, waste elimination, continuous improvement (Kaizen), and workflow stability. When site managers, supervisors, and workers perceive VSM as a practical problem-solving tool rather than additional paperwork, adoption becomes more effective. Empirical studies in Nigeria indicate that weak lean culture and limited awareness significantly constrain the success of lean tools, including VSM (Oyewobi *et al*., 2024; Leart, 2019).

2.5.3. Training and Skill Development

Another critical enabler is training and skill development. Construction professionals require adequate training in how to develop value stream maps, collect accurate process data, and analyse current-state and future-state maps. The lack of technical competence has been identified as one of the most significant barriers to VSM implementation in construction. In Lagos State, where many professionals rely on experiential knowledge rather than formal process analysis tools, targeted training programmes are essential for effective adoption (Md Rahamat *et al*., 2024; Oyewobi *et al*., 2024).

2.5.4. Reliable Data Collection Systems

The availability of reliable data collection systems also strongly supports VSM adoption. Value Stream Mapping depends on accurate data relating to activity durations, waiting times between trades, material delivery lead times, and rework rates. The use of site records, time studies, and digital data collection tools improves the accuracy and usefulness of value stream maps. In many Lagos construction projects, poor data recording practices limit the effectiveness of process analysis, highlighting the need for improved data management systems (Akinradewo *et al*., (2020).

2.5.5. Collaboration among Project Stakeholders

Collaboration among project stakeholders is another essential enabler of successful VSM implementation. Building projects involve architects, engineers, contractors, subcontractors, suppliers, and project managers, all of whom influence material and information flows. VSM works best when these stakeholders share information openly and participate jointly in mapping and improvement activities. In fragmented construction environments such as Lagos State, fostering collaboration across organizational boundaries significantly enhances the effectiveness of VSM (Akinradewo *et al.,* 2021; Leart, 2019).

2.5.6. Use of Modern Construction Technologies

The use of modern construction technologies further enhances VSM effectiveness. Digital tools such as Building Information Modelling (BIM), project management software, and mobile site data-collection applications improve process visualization, data accuracy, and real-time monitoring of workflow. These technologies enable construction teams to better understand and manage complex value streams. However, low levels of technology adoption among many Lagos-based construction firms limit the potential benefits of VSM, making technology integration a key enabling factor (Akinradewo et al., 2020).

2.5.7. Standardized Work Processes

Another important enabler is the presence of standardized work processes. VSM is most effective when construction activities follow clearly defined and repeatable procedures, such as standard methods for concrete works, masonry, and finishing operations. Standardization simplifies the identification of deviations, bottlenecks, and waste, thereby improving the quality of value stream analysis. In environments where work practices are informal or inconsistent, VSM outputs become less reliable (Md Rahamat *et al*., 2024; Naser *et al.*, 2023).

2.5.8. Effective Planning and Scheduling Systems

The adoption of effective planning and scheduling systems also supports VSM implementation. Planning approaches such as the Last Planner System complement VSM by breaking work into manageable tasks, identifying constraints early, and improving workflow reliability. Stable and predictable workflows provide a suitable foundation for value stream analysis and improvement. In contrast, poor planning practices lead to frequent disruptions that undermine VSM effectiveness (Akinradewo *et al.,* 2021; Leart, 2019).

2.5.9. Continuous Improvement Mechanism

The presence of a continuous improvement mechanism is essential for sustaining VSM benefits. Value Stream Mapping should not be treated as a one-off exercise but as part of an ongoing improvement cycle. Regular review meetings, performance monitoring, and feedback loops enable project teams to update value stream maps and sustain improvements throughout the project lifecycle. This is particularly important in Lagos State, where dynamic project conditions require continuous adjustment (Akinradewo *et al*., 2020).

2.5.10. Supportive Organizational Structure

A supportive organizational structure that promotes cross-functional teamwork, open communication, and site-level problem-solving significantly enhances VSM adoption. Organizations that empower teams to identify problems and implement improvements are more likely to achieve successful and sustained VSM implementation. In the Lagos construction context, hierarchical structures and rigid decision-making processes often limit such collaboration, underscoring the importance of organizational support (Oyewobi *et al*., 2024; Leart, 2019).

In summary, the successful adoption of Value Stream Mapping in the management of building construction projects is enabled by a combination of management commitment, lean culture, training, reliable data systems, stakeholder collaboration, technology adoption, process standardization, effective planning, continuous improvement mechanisms, and supportive organizational structures. For building projects in Lagos State, strengthening these enabling factors is essential for translating awareness of VSM into effective and sustained practice.

3. RESEARCH METHODOLOGY

This study employs a quantitative research design, supplemented by limited qualitative insights from open-ended questionnaire items. It allows for the systematic measurement of awareness, adoption, perceived benefits, enabling factors, organizational traits, project features, and challenges related to Value Stream Mapping (VSM). Data collection occurs through a structured questionnaire distributed to construction professionals involved in managing and executing building projects in Lagos State, including architects, builders, engineers, quantity surveyors, and estate valuers. The focus is on Ibeju-Lekki and Eti-Osa Local Government Areas due to their high construction activity levels and growing demand for efficient construction management and lean tools. The sample frame comprises firms that adopt or implement VSM in project management, with stratified random sampling ensuring balanced representation across professional groups. Sample size is calculated using Yamane's formula, based on the total population and desired precision (Yamane, 1967). The questionnaire includes sections on respondents' demographics, VSM awareness, application areas, influencing factors, and success drivers. Responses are mainly captured on a five-point Likert scale; supplementary information comes from academic and professional sources on lean construction, VSM, and construction management. Data analysis

employs SPSS Version 26, with methods such as descriptive statistics, Relative Importance Index (RII), Pearson correlation, multiple regression, and ANOVA. RII ranks the benefits, enabling factors, and challenges of VSM adoption, while regression examines how VSM awareness, enabling factors, and organizational traits predict project performance in time, cost, and productivity. The research aims to advance construction management knowledge by identifying key organizational, managerial, and project-specific factors influencing VSM adoption and impact. It also offers practical strategies to enhance VSM implementation, minimize non-value-adding activities and waste, improve workflow visualization, and boost efficiency, productivity, and value delivery in building projects.

4. RESULTS AND DISCUSSIONS

4.1. Factors Influencing the Use of VSM in Building Construction Projects

Table 4.1 illustrates the factors that influence the application and effectiveness of VSM in building construction projects. The 10 items evaluate project characteristics, organizational capabilities, and environmental constraints. The results highlight that organizational and informational factors are the most critical influencers of VSM usage. "Management Support and Team Collaboration" (Mean = 4.40, SD = 0.60) and "Data Availability and Accuracy" (Mean = 4.32, SD = 0.65) emerged as the highest-ranked influencing factors, both in the Very High category. This underscores that VSM is highly data-intensive and relies heavily on cross-functional teamwork; without accurate historical data and collaborative buy-in, mapping the current state and designing the future state becomes impossible. "Level of Lean Construction Awareness" (Mean = 4.15) and "Level of Technology Adoption" (Mean = 4.05) also scored High, indicating that the broader digital and lean maturity of the firm directly influences how effectively VSM can be deployed.

Conversely, physical and project-specific constraints scored relatively lower, though still within the High or Moderate range. "Worksite Layout and Physical Constraints" (Mean = 3.65) and "Nature of Construction Projects" (Mean = 3.55) were ranked lowest. While the non-repetitive nature of building projects and congested site layouts in Lagos State do pose challenges to standardizing value streams, the data suggests that professionals view these physical constraints as less inhibiting than the lack of management support or poor data quality. The grand mean of 3.95 (High) indicates that while influencing factors are generally favorable, targeted improvements in data management and technological integration are required to fully leverage VSM.

Table 4.1: Descriptive Statistics – Factors Influencing VSM Use

Table 4.1: Factors Influencing the Use of VSM

S/N	Items	Mean	SD
10	Management Support and Team Collaboration	4.40	0.60
3	Data Availability and Accuracy	4.32	0.65
7	Level of Lean Construction Awareness	4.15	0.70
9	Level of Technology Adoption	4.05	0.72
8	Planning and Scheduling System	3.98	0.75
2	Level of Process Standardization	3.90	0.78
4	Complexity of Stakeholder Coordination	3.85	0.80
5	Supply Chain Reliability	3.78	0.82
6	Worksite Layout and Physical Constraints	3.65	0.88
1	Nature of Construction Projects	3.55	0.92
Grand Mean	**Overall Influencing Factors**	**3.95**	**0.70**

4.2. Factors Supporting Successful Adoption of VSM

Table 4.2 outlines the critical enablers and supporting factors required for the successful adoption of VSM in the management of building construction projects. The analysis reveals that strategic leadership and human capital development are the paramount drivers for successful VSM adoption. "Strong Management Commitment" (Mean = 4.55, SD = 0.55) ranked as the highest supporting factor, firmly in the *Very High* category. This aligns with change management literature, which posits that lean tools cannot be successfully implemented as mere "shop-floor" initiatives; they require top-down strategic commitment, resource allocation, and a vision for continuous improvement. Closely following are "Training and Skill Development" (Mean = 4.42) and "Lean Construction Awareness and Culture" (Mean = 4.35). Since VSM requires a specific methodological approach to mapping and analyzing flows, the high ranking of training confirms that capacity building is a non-negotiable prerequisite for adoption.

Technological and systemic enablers also received strong support. "Reliable Data Collection Systems" (Mean = 4.18) and "Use of Modern Construction Technologies" (Mean = 4.08) scored *High*, reflecting the growing recognition that digital tools (such as BIM and cloud-based collaboration platforms) can significantly enhance the accuracy and speed of value stream mapping. "Collaboration among Project Stakeholders" (Mean = 4.12) further emphasizes the relational nature of lean construction. The lowest-ranked, yet still highly rated, factors were "Standardized Work Processes" (Mean = 3.88) and "Supportive Organizational Structure" (Mean = 3.92). The overall grand mean of 4.18 (*High*) demonstrates that the Lagos construction industry possesses a strong understanding of the strategic enablers required for VSM, pointing toward a favorable environment for lean adoption if management commitment is actualized.

Table 4.2: Factors Supporting Successful Adoption of VSM

S/N	Items	Mean	SD	Remark
1	Strong Management Commitment	4.55	0.55	Very High
3	Training and Skill Development	4.42	0.60	Very High
2	Lean Construction Awareness and Culture	4.35	0.62	Very High
5	Collaboration among Project Stakeholders	4.12	0.68	High
4	Reliable Data Collection Systems	4.18	0.70	High
6	Use of Modern Construction Technologies	4.08	0.72	High
8	Effective Planning and Scheduling Systems	4.05	0.75	High
9	Continuous Improvement Mechanism	3.98	0.78	High
10	Supportive Organizational Structure	3.92	0.80	High
7	Standardized Work Processes	3.88	0.82	High
Grand Mean	**Overall Supporting Factors**	**4.18**	**0.65**	**High**

Source: Author field survey (2026)

4.3. Testing of Hypotheses

This section presents the inferential analysis conducted to test the formulated null hypotheses. In alignment with the study's methodological framework, hypotheses evaluating the significance of the constructs' mean scores against the neutral benchmark were tested using the One-Sample T-Test. Additionally, the Pearson Product Moment Correlation (PPMC) was employed to examine the relationships between key variables. All hypotheses were tested at a 95% confidence level ($\alpha = 0.05$). A p-value less than 0.05 leads to the rejection of the null hypothesis. The analyses were executed using the Statistical Package for the Social Sciences (SPSS) version 27.0.

4.3.1. Hypothesis One

$H0_1$: The factors influencing the use of VSM in building construction projects do not significantly differ from the neutral benchmark ($\mu = 3.0$).

Test Statistic: One-Sample T-Test

Decision Rule: Reject $H0_3$ if $p < 0.05$.

Table 4.3: One-Sample T-Test for Influencing Factors

Variable	Test Value = 3.0				
	t	df	Sig. (2-tailed)	Mean Difference	95% CI of the Difference
Influencing Factors	22.72	279	< 0.001	0.95	0.

Interpretation:

As shown in Table 4.3, the mean score for factors influencing the use of VSM is 3.95 (SD = 0.70). The one-sample t-test yields a significant result, $t(279) = 22.72$, $p < 0.001$. Therefore, the null hypothesis ($H0_3$) is rejected. This signifies that the factors influencing VSM utilization, particularly management support, data availability, and technological adoption, are perceived as significantly critical and highly influential by the respondents, rather than being viewed as neutral or insignificant variables.

4.3.2. Hypothesis Two

$H0_2$: The factors supporting the successful adoption of VSM do not significantly differ from the neutral benchmark ($\mu = 3.0$).

Test Statistic: One-Sample T-Test

Decision Rule: Reject $H0_4$ if $p < 0.05$.

Table 4.4: One-Sample T-Test for Supporting Factors

Variable	Test Value = 3.0				
	t	df	Sig. (2-tailed)	Mean Difference	95% CI of the Difference
Supporting Factors	30.41	279	< 0.001	1.18	1.10 – 1.26

Interpretation:

Table 4.4 illustrates the test for the factors supporting successful VSM adoption. With a mean score of 4.18 (SD = 0.65), the analysis shows a highly significant deviation from the neutral benchmark, $t(279) = 30.41$, $p < 0.001$. The null hypothesis ($H0_4$) is thus rejected. This confirms that strategic enablers, most notably strong management commitment, training, and lean culture, are viewed as significantly vital prerequisites for the successful adoption of VSM in the Lagos State construction industry.

4.4. Discussion of Findings

This section critically discusses the empirical findings derived from the data analysis in relation to the study's four research objectives and the existing body of knowledge. The discussion contextualizes the results within the broader discourse on lean construction and Value Stream Mapping (VSM), specifically addressing the unique operational, cultural, and managerial dynamics of the Lagos State construction industry.

4.4.1. The Primacy of Organizational and Human Factors over Physical Constraints

Perhaps the most significant insight from this study is the respondents' consensus regarding the factors influencing and supporting VSM adoption. The data revealed that organizational, informational, and human-capital factors—specifically management support, data availability, team collaboration, and training—are the most critical determinants of VSM success. Conversely, physical and project-specific constraints, such as site layout limitations and the non-repetitive nature of building projects, were ranked as comparatively lower barriers.

This finding challenges the traditional skepticism that VSM is only applicable to repetitive manufacturing environments. It aligns with the work of Sarhan and Fox (2013), who emphasize that the implementation of lean construction is fundamentally a "socio-technical" and organizational change challenge rather than a purely technical one. In the context of Lagos State, where construction projects are often characterized by fragmented supply chains, complex stakeholder networks, and informal site management practices, the data suggests that the industry recognizes that overcoming managerial inertia and fostering a culture of continuous improvement are far more critical to VSM adoption than the physical characteristics of the buildings themselves.

4.4.2. The Imperative of Top-Down Strategic Commitment

A recurring theme across the supporting factors was the paramount importance of "Strong Management Commitment" and "Lean Construction Awareness and Culture." The inferential analysis confirmed that these enablers are viewed as significantly vital prerequisites for adoption. This resonates deeply with change management literature within the built environment, which posits that lean tools cannot be successfully mandated from the "shop floor" upwards. In the Nigerian construction context, where project managers and senior directors hold significant centralized power over resource allocation and procurement strategies, VSM adoption will remain superficial without an explicit, top-down strategic vision and the provision of dedicated resources for training and data collection systems.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The study concludes that informational, organizational, technological, and human-related factors significantly influence the use of Value Stream Mapping (VSM) in building construction projects. The findings revealed that management support and team collaboration (Mean = 4.40) and data availability and accuracy (Mean = 4.32) were the most influential factors, followed by lean construction awareness and technology adoption. Although project-specific and physical constraints, such as worksite layout and the nature of construction projects, were identified as influencing factors, they were considered less critical than informational and organizational factors. The overall mean of 3.95 and the significant One-Sample T-Test result, $t(279) = 22.72$, $p < 0.001$, confirm that the identified factors significantly influence VSM use and are substantially above the neutral benchmark.

The study further concludes that successful adoption of VSM requires strong management commitment, adequate training and skill development, a supportive lean construction culture, stakeholder collaboration, reliable data systems, and appropriate construction technologies. Strong management commitment recorded the highest mean score (4.55), followed by

training and skill development (4.42) and lean construction awareness and culture (4.35), demonstrating the importance of strategic leadership and human capacity in VSM implementation. The overall mean of 4.18 and the significant One-Sample T-Test result, $t(279) = 30.41$, $p < 0.001$, confirm that these supporting factors are significantly important for successful VSM adoption. Overall, the findings establish that VSM implementation in the Lagos state construction industry is primarily a socio-technical and organizational challenge, requiring management commitment, competent personnel, reliable information, collaboration, and continuous improvement rather than relying solely on physical project characteristics of technological tools.

5.2. Recommendations

1. Strengthen Management Commitment and Organizational Support: Construction firms should ensure strong top-management commitment to VSM implementation by providing adequate resources, establishing clear implementation policies, and integrating VSM into project management and continuous improvement strategies. Senior management should actively participate in VSM activities rather than treating them as site-level initiatives.
2. Invest in Training and Capacity Development: Construction organizations should provide regular practical training and skill-development programmes on VSM, lean construction principles, data collection, current-state mapping, and future-state mapping. Professional bodies and construction firms should incorporate practical VSM training into continuing professional development programmes to close the identified gap between theoretical awareness and practical competency
3. Improve Data Management, Collaboration, and Technology: Construction firms should establish reliable systems for collecting, storing, validating, and sharing project information to improve the accuracy of VSM analysis. The adoption of suitable digital technologies, including BIM and cloud-based collaboration platforms, should be encouraged to support data-driven mapping and workflow analysis. Additionally, project stakeholders should be encouraged to collaborate throughout the VSM process to enhance information sharing, identify non-value-adding activities, and support ongoing improvement.

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