

# Time and Cost Variations on Performance of Infrastructure Development in Kenya: A Case Study of LAPSSET Corridor Development Authority

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**Abstract:** Infrastructure development is vital for socio-economic advancement, providing the foundation for economic growth, social progress, and improved quality of life. In Kenya, major projects such as the Standard Gauge Railway (SGR) and the LAPSSET Corridor have become central to the national development agenda. However, these initiatives often face significant challenges, particularly regarding time delays and cost overruns. This study focused on the LAPSSET Corridor Development Authority (LCDA) to examine how the Schedule Performance Index (SPI), and Cost Performance Index (CPI) influence infrastructure development performance. The research aimed to provide actionable recommendations to improve project management practices, enhance stakeholder collaboration, and promote sustainable infrastructure development in Kenya. The findings are intended to guide policymakers and project managers in addressing persistent delays and cost overruns, ensuring more efficient and cost-effective project delivery. Study was grounded in the Resource-Based View, Institutional Theory, and Goal-Setting Theory. The target population consisted of 100 participants, and a census approach was used for sampling. Data were analyzed using SPSS v.28, and inferential statistics were employed to assess the relationships between variables, while ethical guidelines were strictly observed. Results revealed that LCDA performance was significantly and positively correlated with SPI, suggesting that improving schedule performance would enhance overall project outcomes. Similarly, CPI showed a strong positive correlation with performance, indicating the importance of effective cost management. Depending on SPI results, it may be necessary to revisit the schedule baseline or implement adjustments such as expanding teams, reallocating tasks, or designing more flexible future schedules and suggests further research to identify additional factors influencing LCDA performance.

**Keywords:** LAPSSET Corridor Development Authority, Schedule Performance Index, and Cost Performance Index, Infrastructure Development Performance.

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## I. INTRODUCTION

### ➤ Background of Study

Heavy investments howl in the infrastructure sector in Kenya, with ambitious development roads leading to the roadmap of national development and rejuvenation. With such a commitment to set more than 30% of the national budget towards infrastructure investment every year, Kenya is also driving very crucial investments aimed at realizing its Vision 2030. Kenya is a state industrially taking off at this juncture, let us note that "taking off" represents an upward

elevation of an aeroplane into the sky from the ground (Onuoha & Agbede, 2019). Its inch-by-inch pushes its citizens to the status of a middle-income economy through intense industrialization, incarnating through initiatives whose impacts are already sending far-reaching developments in the local economy, social fabric, and overall quality of life. Infrastructure is the epitome of world-building. Infrastructure forms the mast that holds economic growth and societal development. This does not make it a sentiment of hearts strung along borders but rather a realization independent of geography. After all, it does stamp the fact

that the arteries of transportation, the veins of energy distribution, and the lifeblood of water management are the core of a thriving economy (Kassa, 2020).

No wonder the importance of infrastructure development, forming a central pillar in multidimensional approaches to poverty reduction, diversification of economies, sustainable development, etc., is reflected by the World Bank, amongst numerous international development institutions. It goes on to project a world in which the bite at strategic infrastructure spends that cease to be expenses turn into vital investments in humanity's collective future, bearing tangible and deep economic dividends. The term "performance" is frequently used in a variety of settings. Although evaluating the functioning of infrastructure is a complicated task, the term is typically understood to refer to providing clean water, transporting people and products between locations, or eliminating trash (NASEM, 2021). According to a dictionary definition, "performance" is the completion of a task or the fulfilment of a promise or claim. Infrastructure performance is the accomplishment of the responsibilities given to the system or its constituent parts by the society that builds, operates, employs, or is adjacent to that infrastructure. In summary, the general public establishes the criteria for evaluating the performance of infrastructure. This community encompasses both local and national perspectives, as was previously said. There may therefore be a wide range of performance metrics, and they may differ depending on the location (Scala, Alves, Hawkins, & Schiavone, 2024). Communities might decide to gauge performance using particular metrics that represent their own goals. The metrics, which assess performance on effectiveness, dependability, and cost, typically fall into three major categories. Infrastructure is operating successfully when it consistently meets or surpasses the expectations of the general public at a reasonable cost (NASEM, 2021).

Empirical research shows that infrastructure projects have underperformed and have been marked by delays, cost overruns, and short life spans in both industrialised and developing nations. From a global perspective, Ibrahim, Thorpe, and Mahmood (2019) investigated risk factors that impact earned value management's capacity to precisely evaluate the performance of infrastructure projects in Australia. According to findings, earned value management, or EVM, is a particularly common method for assessing project performance. A limitation of this approach is that the EVM evaluation in its current configuration fails to sufficiently examine the impact of multiple project performance metrics that emerge from the intricacy of modern infrastructure development projects. A number of potential risk factors are examined and clarified in order to evaluate project performance. These include sustainability, stakeholder requirements, communication, procurement strategy, weather, staff experience, site condition, design issues, financial risk, subcontractor, government requirements, and material. They were also acknowledged for their measurement devices.

Kakar, Hasan, Jha, and Singh (2024) investigated the cost performance variables of infrastructure projects in the

conflict-sensitive and war-affected Afghan construction sector. According to this report, the main reasons for cost overruns in Afghan public projects include a lack of funding, inadequate project management abilities, and procurement corruption. Additionally, this study found five hidden elements that affect cost performance: project characteristics, governance and public procurement, team competency, political support, and planning and risk management. Nigerian PPP infrastructure projects' sustainability practices were examined by Babatunde, Ekundayo, Udeaja, and Abubakar (2022). The majority of public sector officials and consulting firms who responded to the survey admitted to including sustainability requirements in their bid documents for PPP infrastructure projects, indicating that all respondents are well-versed in sustainability fundamentals. Three facets of sustainability—economic, environmental, and social factors—were found to have sustainability traits. Additionally, the study found that minimal maintenance costs, which are thought to be the most essential factors. Similarly, biodiversity, energy consumption while operation, and energy use during building were environmental factors of sustainability, according to the study. Additionally, the research showed that the three social components of sustainability that were scored highest were health and safety, stakeholder equity, and education.

Ghanaian energy infrastructure projects' performance was evaluated about disruptive technologies by Seidu et al.(2023). A study found that the application of DTs improves performance of energy infrastructure projects by 18.4%. DTs speed up operations in energy projects, lower operating costs and increase project efficiency, promote sustainable economic development, increase project security, and improve environmental sustainability, in that order of significance. Additionally, the study found that the top-ranked DTs that had the biggest effects on the performance of energy infrastructure projects were e-commerce and renewable energy technologies. Lungi Bridge project and the Sierra Leone infrastructure plan were the subjects of Oliveros-Romero et al (2023) examination of the development of infrastructure. This study looks at the benefits and drawbacks of employing a PPP option for a number of projects that involve special-purpose vehicles, off-balance sheet treatment, and non-sovereign guarantees. The societal risk of mistaking the bridge for an essential, required, and involuntary form of transit is also covered.

Awuzie et al. (2024) examined the performance of insured and outsourced public infrastructure projects in a South African provincial department of public works. The study's conclusions demonstrated that the PDPWI lacked a systematic method for assisting in decision-making process regarding insourcing or outsourcing of consulting services for building projects. Additionally, the study found that both strategies produced comparable outcomes of cost, time, and quality. Furthermore, the study offers a thorough understanding of the procedures necessary for the effective use of GTM.

In Kenya, Standard Gauge Railway is at the forefront of this infrastructure transformation, spearheading federal

efforts to restructure transportation to streamline cargo transit and, at the same time, bring the government closer to the people. Kenya strategically views itself as both an economic powerhouse in Africa and a vital link to her neighbors against this positive backdrop of feasible projects, which includes the ongoing electrification effort and the LAPSET corridor. In many cases, though, the trip has not been as easy. The large visions are difficult to realize because of the nuances of the attributes, the complexity of time, and the variances in cost. Kenyans are inspired to repeat their ambitious infrastructure goals after seeing the SGR, which is a modern engineering marvel. For intra-regional trade, economic integration, and participation, the time it takes to transport or transmit goods—from Mombasa to Nairobi and neighboring Uganda, Rwanda, and South Sudan—is crucial. It is a step in the right direction towards rethinking logistics in East Africa. It will undoubtedly increase the region's attractiveness to foreign investors as it solidifies its position in the global trade arena. The LAPSET corridor is another example of Kenya's innovative methods of infrastructure development (De Soyres et al., 2020). The massive project is expected to span South Sudan, Ethiopia, and Kenya and include pipelines, data cables, railway lines, and roadways. It is not possible to connect A to B since LAPSET is opening up rural places, energizing underdeveloped areas, and encouraging a spillover of prosperity across borders. By doing this, LAPSET hopes to achieve a convergence of the region's competitive and integrated economic frontier, fostering more economic cooperation and operational synergies among East African nations.

#### ➤ *Performance of Infrastructure Development Projects*

Performance is linked to other ideas that are employed in decision-making and infrastructure management. Among these is the idea of "need." The phrase and the technical principles that underpin it are frequently used in public works policy research, particularly when figuring out how much money should be allocated for state highway building. Because of the multitude of measures describing performance and the different points of view of stakeholders, judging whether performance in a particular situation is "good" or "adequate" may not be easy. Issues of scale and aggregation influence the assessment. For instance, although infrastructure is supposed to deliver its many services consistently over extended periods, service interruptions are always possible. Although structural problems, abnormally high demand, necessary maintenance, and other factors can occasionally create interruptions, a certain amount of redundancy. However, even if they believe that some service interruptions are theoretically acceptable, those who are immediately impacted by local disruptions are probably not entirely content.

In a similar vein, infrastructure services for one user can interfere with those for other users. Performance is ultimately related to the results of its use, such as regional economic growth and quality of life since higher levels of infrastructure design supports social and economic activity without harming the environment. However, it is challenging, unpredictable, and probably going to be attempting to measure the connection between investments and infrastructure

operations on the one hand, and these outcomes on the other, is controversial. Four dimensions were used by the NCPWI to describe performance: cost-effectiveness, service delivery, user quality, and physical assets. According to Langston (2024), performance encompasses both efficacy and efficiency. However, he pointed out that project cost and completion time are the most often mentioned factors as well as quality. Completion time, cost, and quality performance of infrastructure projects are the metrics used in this study to evaluate their performance.

#### ➤ *Schedule Performance Index*

Schedule performance index (SPI) itself is the ratio of the obtained value to the expected (or actual) value. Depending on the integer, SPI shows whether a project is on, behind, or ahead of time. The schedule performance index can also be thought of as a tool to measure the value of completed work. SPI does this by comparing the progress we really made with the progress we expected. That is, how precise is our project timeline? There are several factors to be mindful of if this project timetable is deviated from (Sun & Zhang, 2023). SPI is essential for improving decision-making and preserving project oversight. It gives project managers a precise indicator of find out if a project is on track, which is essential for efficient resource allocation. Managers can swiftly determine when a project's progress is behind by monitoring the SPI, which enables them to look into and address problems as soon as possible. By being proactive, you can save small hiccups from turning into big delays. Additionally, SPI promotes transparency and better communication by helping stakeholders understand the state of the project. There is less chance of resource waste and expense overruns when projects are completed on time. Additionally, benchmarking across several projects is made possible by the SPI, which offers insights into performance and efficiency (Yang & Lai, 2024).

#### ➤ *Cost Performance Index*

One tool for assessing a project's financial performance is the cost performance index. Additionally, it can help to increase the cost-effectiveness of budgeted resources. The cost performance indicates if the project is successfully adhering to its budget. Project budget is merely an approximation of the final cost. However, once accepted, that budget determines the costs of your project (Asiedu & Adaku, 2020). The project may not succeed if the budget is exceeded. The broader earned value management approach includes the cost performance index in infrastructure management performance. To forecast the future and enable project managers to modify their projects appropriately, it is predicated on the anticipated and actual values of certain indicators. Utilizing the cost performance index improves the likelihood that projects was finished on schedule and aids in cost tracking. Another option for controlling project expenses is project management software (Kakar, Hasan, Jha, & Singh, 2024). Using the following formula, CPI determines a project's cost-effectiveness and financial efficiency: EV divided by AC is the CPI. When the ratio is more than 1, it means that the project is doing well financially. Project is operating within budget if its CPI value is 1. A project is over budget if the CPI value is less than 1. (Lee, 2019).

### ➤ Problem Statement

Under ideal circumstances, infrastructure projects would be finished effectively, on schedule, and within budget, improving the nation's transportation system and generating economic advantages (Kisavi, 2019). However, issues like cost overruns, delays, and subpar quality frequently plague infrastructure projects, which can have a detrimental effect on their effectiveness. According to one study, road construction projects in Kenya frequently had delays and cost overruns, with an average delay of 21 months and a cost overrun of 45% (Ochieng & Ochieng, 2021). Another study found that poor project management, poor project planning, and poor stakeholder coordination were often the causes of poor road-building project performance in Kenya (Odongo & Mugenda, 2019). Significant economic repercussions, such as diminished GDP, slower economic growth, and diminished competitiveness, may result from these difficulties. According to Ndurya and Bii (2019), just 20% of road projects in Kenya are finished on schedule and within budget, 50% of them go over budget, and 30% of all road projects in the country stagnate. The Thika Super Highway project, for example, saw a 23.25% increase in cost, going from 26.44 billion to 34.45 billion (Mwita, 2020).

Furthermore, the project's original July 2011 deadline was changed to July 2013. Furthermore, according to the Kenya Roads Board, 76% of the 29 road projects that KeNHA was responsible for implementing during the 2018–19 fiscal year were behind schedule. Nine out of 24 projects, or 37.5% of the road-building projects that were anticipated to be finished by December 2018, had gone beyond their contractual completion dates, according to the Kenya Urban Roads Authority's (KURA) December 2018 projects progress report. For example, from September 2017 to July 2018, the Outer Ring Road Upgrade project took 24.8% longer than expected to complete. The road works' quality has also declined, which has resulted in a shorter lifespan (sustainability) for public infrastructure. This has been attributed to shortcomings in the construction project supervision system (World Bank, 2017). By offering a formal framework for creating, monitoring, and modifying project plans, the use of project planning as a practice within a Project Management Information System (PMIS) improves project performance. Project managers can improve coordination and guarantee that all project activities are in line with overall objectives by using the PMIS to establish precise schedules, assign resources, and set milestones (Bor & Chepnoen, 2018).

It is easier to manage dependencies and deadlines when plans can be updated in real-time and project timeframes can be visualized using tools like Gantt charts. In the end, this thorough planning method results in more effective execution and excellent project outcomes by reducing risks, managing resources well, and quickly adapting to changes. Therefore, using project planning as part of PMIS in construction will help to improve project performance (Odongo & Mugenda, 2019). Numerous studies on impact of project planning techniques on outcomes of road construction projects have been carried out in Kenya. Mwanza, Namusonge, and Makokha (2020) conducted a study to evaluate the impact of project planning practices on construction project

performance, and Muute and James (2019) studied the relationship between project planning practices and construction project performance in Nairobi County. These studies, however, concentrated on building construction, which differs from infrastructure development projects in terms of the resources needed, the goals, and the scope. This study sought to determine time and cost variations on performance of infrastructure development projects in Kenya a case of LCDA.

### ➤ Objectives

- To assess the effects of the schedule performance index on the performance of infrastructure development at the LCDA.
- To evaluate the effects of the cost performance index on performance of infrastructure development at the LCDA.

### ➤ Significance of the Study

Theoretical Significance; Time and cost deviations in infrastructure development are complex and multi-dimensional, affecting multiple stakeholders and undermining overall project objectives. These challenges highlight the importance of project management protocols such as detailed planning, risk management, and cost performance indicators in minimizing risks (Enns & Bersaglio, 2020). This study will advance theory by positioning cost variance analysis as a strategic tool that government institutions and organizations can apply to improve performance. By linking leadership decisions to key drivers of project success, the study will enrich the theoretical framework on infrastructure performance and contribute to the academic discourse on project management and public sector development.

At the policy level, the study's findings will be valuable for both national and county governments, as well as other institutions mandated to deliver infrastructure. The evidence will help evaluate whether existing performance management systems adequately address cost and time challenges and will guide policymakers in developing transformative strategies for effective and efficient project delivery. By framing cost variance analysis as a performance-based approach, the study introduces a novel perspective for designing organizational policies that support timely, transparent, and sustainable infrastructure development.

In practice, the LAPSET Corridor Development Authority (LCDA) and other organizations will gain deeper insights into the role of performance management in Kenya's infrastructure projects. The study will identify existing gaps and provide data that scholars, practitioners, and students can use as a reference for decision-making and future research. It will also foster dialogue on the broader impacts of infrastructure development while emphasizing the adoption of improved strategies that enhance performance, particularly within state parastatals.

## II. THEORETICAL LITERATURE REVIEW

### ➤ *Resource-Based View Theory*

In 1959, Penrose (1959) established this theory, but Wernerfelt's work in 1984 helped make it more widely known for its applicability in analyzing the Performance of infrastructure development projects (Kozlenkova, et al, 2014). Wernerfelt asserts that a company's internal resources are the true determinants of its infrastructure development project performance and profitability. "RBV" often denotes the viewpoint that values resources. This early understanding of the resource-based view is attributed to Penrose's research from that year (Kozlenkova, Samaha, & Palmatier, 2014). The way these materials are arranged makes it appear as though the company already uses them internally. Jay Barney promoted the advantages of the RBV perspective, and his writings have since become more well-known. He outlined the key internal resource characteristics and their connection to competitive advantages, a company has a competitive advantage when it can increase the economic worth of its nearest competition in a certain market (Kozlenkova, et al, 2014).

According to Gills, Combs, and Ketchen (2014), not all organizational resources are necessary they must produce a competitive advantage. An organization's wealth must be hard to duplicate, replace, or transfer in order for it to reach the point where it may make a profit. According to Gills, Combs, and Ketchen (2014), The ability to employ company resources, which are inventories of immediately usable components possessed by the firm, differs from the corporation's competencies. The features and forms of resources that generate an edge, higher Performance of infrastructure development projects, and competitive advantage are all components of the RBV theory (Gillis, et al, 2014). Kozlenkova, (2014), RBV refers to the use of a variety of a firm's accessible tangible and intangible resources. Any company needs a wide range of resources if it is to convert its organisational strategy into sustained financial success. The RBV makes it evident how a business can outperform its competitors. The RBV hypothesis gives the organization's internal resources top priority while implementing its strategy. RBV theory proponents like Jensen, et al (2016) contend that for businesses to perform better, it is preferable to repurpose current resources as opposed to trying to acquire new resources or skills for every opportunity. RBV also contends that schedule performance indexes are important Performance of infrastructure development project indicators that enhance a company's competitiveness and Performance of infrastructure development projects and can establish and preserve an economic gain (Hitt, et al, 2016).

Although core resources are significant drivers of the performance of infrastructure development projects, the RBV theory is constrained by its exclusive emphasis on the internal environment as a means of maximizing a company's superior performance of infrastructure development projects (Gillis, Combs, & Ketchen, 2014). The RBV's competitive advantage and Performance of infrastructure development projects are impacted by external environment. In actuality, external factors have an equal impact on a company's performance in

the market when it comes to infrastructure development initiatives. Laws and regulations, taxes, sectoral policies, and compliance procedures are examples of external influences that impact how businesses function in the marketplace. When examining variables that could affect the tactics it uses, external resources must also be taken into account. To study strategies that produce superior Performance in infrastructure development projects, it is vital to consider both external factors and a firm's internal resources, as suggested by theory (Hitt, et al, 2016). Despite its flaws, the theory is chosen as an extra notion. In addition to the variables in this study that are supported by this theory, the RBV is still a vital principle that describes how a business can use its resources to improve the performance of infrastructure development projects. schedule performance index, cost performance index and performance of infrastructure development projects.

### ➤ *Institutional Theory*

Goguen and Burstall came up with this concept in 1984. The strategy highlights how the environment of the organisation plays a crucial role in determining its composition and actions. Even if an organisation does not want to, changes in the business environment may force it to reinvent itself or create a new strategy to implement. The concept has centred on the ways in which the organisational environment influences both commercial activities and organisational structure. Institutional theory holds that rather than being solely guided by well-planned and logical objectives, organisational actions are also impacted by social and cultural factors that are thought to be suitable given the organization's structure. According to the theory, institutions become similar as a result of pressure for authenticity, implying that businesses dealing with comparable products are more inclined to adapt to continuously changing client needs by emulating their market leaders (Gauthier, 2013). Furthermore, the theory emphasizes organizational social behavior, defining formations, practices, and protocols as organizational strategies (Aksom & Tymchenko, 2020). A framework for examining how companies interact with their employees and other stakeholders, as well as how technology may facilitate the development of that relationship over time, is offered by the institutional theory. Modern organisational tactics, procedures, and structures, as well as policies, can still benefit from the theory.

Organisations' interactions with different stakeholders in their environment might influence how they determine how employees' careers will develop in certain competitive and unstable environments. Institutional theory holds that rational goals are not the main driving force behind organisational decisions. The concept is used in the study to explain how social norms and laws that affect the way infrastructure development projects based on organisational technology perform can change an organisation. This study extended this theory to the key areas that impact leadership in developing business plans, policies, and procedures, demonstrating how they are embedded when the organisation engages with its environment, which impacts its operations. The study also used the theory, additionally variables backed by this theory include the schedule performance index, cost

performance index and Performance of infrastructure development projects.

#### ➤ *Goal-Setting Theory*

This theory was developed by Dr. Edwin Locke, who began investigating it in the 1960s, building on Kurt Lewin's early studies on degrees of aspiration (Locke & Latham, 2010). Goal is the intended outcome of activity or action that a person consciously strives to accomplish. In order to attain desired outcomes, setting objectives requires a purposeful process of selecting performance criteria (Latham, 2010). Theory, motivation stems from will and determination to achieve a goal. If individuals or groups find that their current performance is not producing the desired results, they are frequently urged to increase their effort or modify their strategy (Locke & Latham, 2010). According to Locke and Latham (2010), when someone is working toward a goal, they don't seem content until the goal is accomplished. Since they are challenging to accomplish within the organization's time restrictions, the hardest goal lines are used as a benchmark to measure levels of satisfaction and discontent. When goal-setting is applied to evaluate an individual's performance, it implies that in order to create an environment that will enable them to realize their full potential, an individual's goals should guarantee that their fundamental needs—like a stable job and a safe place to live—are met (Ferris, 2007). According to Ferris (2007), goal-setting is a synthesis of concepts from decision theory used to analyze productivity and motivation. According to Kinicki (2013), this theory lays a lot of emphasis on perception's role in the cognitive ability to predict the outcomes of behavioral action.

First, people perceive the concerns that result from their interactions with others and the causal relationships between the outcomes; second, people respond effectively to certain outcomes, both positive and negative in nature (Amit & Livnat, 2008). These are the two main tenets of goal-setting theory. Determining the probability that an undertaking will consistently provide the intended result should be the main goal. Determining the probability that a certain performance will have the intended results is the second objective. Even if their efforts are not recognised, the employee will not be motivated to complete a certain assignment. When conduct is driven by internal forces, rewards from external sources are perceived as extrinsic motivators rather than intrinsic motivators (Ferris, 2007). Maturity, certainty, and accountability are necessary in relation to the study. The process of operating an organisation in accordance with its aims is transformed when its goals are established. Since they are aware of their expectations, after that, workers can establish their own objectives. The study embraced this idea because to its strong association with the dependent variable of performance of infostructure projects.

### III. EMPIRICAL LITERATURE REVIEW

#### ➤ *Schedule Performance Index*

Schedule Performance Index (SPI) is a ratio that compares the value of work actually completed to the value that was planned. It indicates whether a project is on, behind, or ahead of schedule, essentially measuring the accuracy of

the project timeline. Any deviation from the planned schedule highlights risks that require managerial attention (Sun & Zhang, 2023). SPI is a critical tool for decision-making and project oversight. It enables managers to monitor progress in real time, identify delays, and take corrective measures before small setbacks escalate into major challenges. Furthermore, it promotes transparency by providing stakeholders with a clear picture of project status. By ensuring projects stay on schedule, SPI reduces the likelihood of wasted resources and cost overruns. Additionally, it supports benchmarking across projects, generating insights into performance and efficiency (Yang & Lai, 2024).

Yang and Lai (2024) investigated the use of EVM, ESM, and EDM in construction project schedule management. to examine earned value management (EVM)-related techniques, such as EDM, ESM), and original EVM. A general implementation process and some fundamental guidelines for choosing EVM-related techniques are then suggested by this study. Following a thorough analysis of the literature, this study uses the EVM, ESM, and EDM(t) techniques to execute a case study to investigate the project duration forecasting performance. ESM with performance factor of 1 is suggested approach when the project is anticipated to be completed on schedule. If EDM(t) is anticipated to be delayed based on prior experience, then EDM(t) would be most dependable approach throughout a project. The conclusions may not apply to other kinds of construction projects because this study only looks at one building construction project, creating a contextual gap.

For Shanghai apartment developments, Ma and Wu (2020) looked at an FMEA-based construction quality risk evaluation model that took project scheduling into account. This study assesses the building quality of 311 Shanghai apartments using FEM analysis. EVM technique is also used by the authors to assess construction-scheduling control, and the results are correlated using an artificial neural network. Next, using Big Data, the authors create a quality risk and schedule correlation model. The methodology provides a novel way to evaluate the connection between project scheduling and risk. The findings indicate that the relationship can be more accurately described by the suggested model. Only quality risk under the influence of scheduling is subject of methodology. To enhance quality management, future work may concentrate on creating a model that links failure models to project budgets and deadlines.

The maturity model was applied in an extended manner for collaborative scheduling in construction projects by Scala, Alves, Hawkins, and Schiavone (2024). The MMCS was programmed into a survey that included a wide range of construction-related themes, with a concentration on five pillars (key areas of concern for CS) and associated swim lanes (specific attributes). Following that, the group of subject matter experts (SMEs) employed the Delphi method to ascertain the relative weights of the pillars and swim lanes. MODA was used to analyse the results, and 241 responses to a survey that included questions from the MMCS—which included institutions from all over the US industry—were

used to validate the results. The project scoring establishes boundaries for scheduling collaboration. Evaluations of the project can then be utilized to pinpoint areas that require improved cooperation and ongoing development. We provide suggestions and best practices for enhancing projects. This work led to two original contributions: To strengthen the use and continuous improvement of CS practices, the study applied a validated model to assess the maturity level of CS in construction projects and offer recommendations for advancement. A three-level maturity scale was also developed and validated using a combination of Delphi, MODA, and survey methods. This approach enables project managers to evaluate performance, enhance project maturity, and support ongoing collaboration improvements.

Using a multi-criteria decision model, Afzal, Yunfei, Sajid, and Afzal (2020) investigate the crucial components of complexity-risk interdependency for cost chaos in the construction management domain. Using expert assessment and literature, a total of 60 risk attributes and 12 complexities are first identified. A real-time Delphi approach is used to record and assess expert comments to create a structured hierarchy of important complexity and risk factors. IPDI analysis showed that contingency and escalation cost uncertainties are the key drivers of project cost overruns. Other important factors like "the use of innovative technology," "multiple contracts," "low advance payment," "change in design," "unclear specifications," and "the lack of experience" seem to be more important. Since the judgement process's ambiguity and vulnerability were not addressed in this study, fuzzy logic can be used to expand this framework and more accurately assess the importance of cost-chaos drivers.

#### ➤ *Cost Performance Index*

One of the key tools for evaluating a project's financial performance is the CPI. It not only measures whether a project is adhering to its budget but also helps determine the cost-effectiveness of the resources allocated. Although a project budget is only an estimate of the final cost, once approved, it sets the financial boundaries within which the project must operate (Asiedu & Adaku, 2020). Exceeding this budget can jeopardize the project's success. CPI is part of the broader Earned Value Management framework commonly applied in infrastructure project management. It relies on both planned and actual values of specific indicators to forecast future performance, enabling managers to make timely adjustments. By tracking CPI, managers can improve cost control, enhance the likelihood of completing projects on schedule, and maintain financial discipline. In addition, project management software provides another useful option for monitoring and controlling expenses (Kakar, Hasan, Jha, & Singh, 2024).

CPI is calculated using the formula:  $CPI = EV \div AC$ , where EV is Earned Value and AC is Actual Cost. A CPI greater than 1 indicates the project is performing well financially; a CPI equal to 1 means it is on budget; and a CPI less than 1 signals the project is over budget (Lee, 2019).

Since the topic is not covered in the literature, Clayson, Thal, and White III (2018) look into the stability of the cost performance index (CPI) for environmental remediation projects. Following the acquisition of monthly earned value management (EVM) data from a government agency in the United States for 136 environmental remediation projects The authors examined CPI stability the authors also employed nonparametric statistical comparisons. It wasn't until environmental initiatives were 41% finished in terms of project duration that the CPI stabilized. The following managerial insights were used to classify the most important aspects that contributed to CPI stability: competition, EVM considerations, qualifications, communication, and macro project factors. Since environmental restoration project CPI stability has not been documented in the literature, this study offers fresh perspectives to assist project managers in determining when environmental remediation project CPIs stabilize and which factors most influence CPI stability.

Using a systems thinking modelling method, Mahmud, Ogunlana, and Hong (2022) investigated cost overrun triggers in Nigerian infrastructure projects. Numerous factors may contribute to poor cost performance in roadway projects, according to empirical findings. On the other hand, earlier research on the cost overrun trigger was positivist and based on traditional statistical methods, ignoring the complex relationships and general dynamics of the triggers. By taking a comprehensive approach. Nigerian industry stakeholders participated in semi-structured interviews, which were supported by textual information from project documentation and literature sources. This model was verified by specialists. The identification of action items that were utilized to propose modifications for better, more economical highway project delivery was made possible by the examination of the causal loop diagrams (CLDs). One of the recommended interventions is making sure that sufficient funds are provided before contract award, which ensured that projects are delivered on time and that important projects are delivered at the agreed-upon budget. This can be accomplished by making sure that the Nigerian Public Procurement Act, 2007's Section 4(2)(b) is strictly followed. Because study only looked at highway projects, care must be used when applying the findings to other situations both inside and outside of Nigeria.

Teng and Tsinopoulos (2022) investigated the relationship among supplier integration, cost performance, and information systems (IS) capabilities in the context of services. In particular, it examines empirically how supplier integration influences the relationship between service organisations' cost performance and three aspects of IS capabilities. A survey of 156 UK service firms showed that supplier integration plays a key role in cost performance. SEM and neural network analysis revealed that it partially mediates the impact of managers' IT expertise and fully mediates the effects of IT for supply chain activities and flexible IT infrastructure. Findings indicated that the best indicator of supplier integration is the operations manager's IT expertise. By advancing and validating the measurement of IS capabilities in the context of service operations, this study helps allay worries over the business value of IS. It also contributes to the growing corpus of research that links

service organisations' operational success and supplier integration.

#### IV. METHODOLOGY

##### ➤ Research Design

According to Bickman and Rog (2018), research design is the way the technique and goal of the study are structured, and as a result, a theoretical framework is used to conduct the research enquiry. For this investigation, a descriptive design was used. Because it guarantees that data acquired offered relevant answers. The design was used to explain the population's features or analyse issues. This method has the

advantage of helping researchers plan and carry out investigations that provide a thorough grasp of the topics, environments, or specific problems (Bickman & Rog, 2018). The main goal of research design is to turn research questions to project.

##### ➤ Target Population

The target population is defined by Cooper and Schindler (2018) as the entire group of variables that one intends to generalize from the findings. Saunders, et al (2018), define a population as the whole assembly of factors that the study conclusion should be generalized. As shown in Table 3, population was 100 respondents.

Table 1 Target Population

| Category              | Target population | %          |
|-----------------------|-------------------|------------|
| Senior Management     | 10                | 10         |
| Middle-level Managers | 30                | 30         |
| Officers              | 60                | 60         |
| <b>Total</b>          | <b>100</b>        | <b>100</b> |

##### ➤ Sample and Sampling Technique

According to Taherdoost (2021), a sample is one that accurately represents the population's features. Cooper and Schindler (2018) stated that to avoid biases, the study sample size should be random. All respondents participated in a census for the project. A census, according to Saunders et al (2018), is a method of gathering and recording information about a given population. Due to the size of the target demographic (100), census was used.

is another important factor (Cooper & Schindler, 2018). Cooper and Schindler (2018) stated that to avoid biases, the research pilot size should be random, and 1-10% of the sample size is considered an appropriate size. The pilot study was carried out with the participation of 10 participants which is 10%, that was randomly selected from the KPA which has similar projects.

##### ➤ Research Instruments

The primary tool for collecting data for the study was the questionnaire. Saunders et al. (2018) state that the researcher used questionnaires since they facilitate and enable descriptive, inferential, and correlational statistical analysis. Additionally, the qualitative technique was successfully enhanced by these questions (Saunders, Lewis, & Thornhill, 2018). Because it has been used by other researchers in the same field and is believed to be more accurate and efficient in terms of labor, money, and time, as well as because it helps gather both qualitative and quantitative data and offers more structure than interviews, the questionnaire was used in the study (Thornhill, Lewis, & Saunders, 2018). Note that the questionnaire's single limitation is that it cannot be administered to individuals who are illiterate, meaning they are unable to read or write. Despite this, questionnaires are thought to be less expensive data collection tools, and the researcher can collect large volumes of data (Creswell & Creswell, 2018).

##### ➤ Validity

Validity, according to Saunders, et al (2018), is the ability of a research instrument to yield anticipated results. Before the research instrument is sent to the sample group, the validity test's goal is to find and fix any problems. This was done while the instrument is being piloted (Saunders, Lewis, & Thornhill, 2018). The process's goal is to ascertain whether the instrument responses provided the data required to help the study meet its goals as outlined in the methodology (Cooper & Schindler, 2018). The supervisor and subject-matter specialists ensured that the study uses content validity. Face validity was used in the study and it is significant since it offers a straightforward way to assess a test's or technique's overall validity. It's a rather simple, quick, and straightforward technique to begin determining whether a new statistic is beneficial immediately (Cooper & Schindler, 2018).

##### ➤ Reliability

Saunders, Lewis, and Thornhill (2018) define reliability as the ratio that is used to assess the consistency of research questionnaires. Test-retest reliability measures the consistency of results when a study performs the same test on the same sample at a different period. To evaluate test-retest reliability, the same test was given to the same group of participants twice. The researcher then ascertained the correlation between the two sets of results. reliability was assessed using Cronbach's alpha, with a threshold of 0.70 applied as the acceptable standard. According to Taherdoost (2021), if research tools are reliable, they should provide identical results to the pilot study when applied to a larger sample size, as substantiated by Cooper and Schindler (2018).

##### ➤ Pilot Study

According to Bordens and Abbott (2017), a pilot study is a small-scale, preliminary investigation that is conducted before a larger study to test and enhance research procedures, data collection methods, and other study components, ultimately improving the design and viability of the main study. By performing a pilot study, it is feasible to identify unclear questions and confusing instructions in an instrument (Taherdoost, 2021). The pilot study's establishment of the validity and reliability of research data collection equipment

### ➤ Data Collection Procedure

Researcher requested permit from NACOSTI, LCDA for approval to conduct the study and the university for a letter of introduction. The researcher distributed the questionnaires to various respondents and 5 days later were collected to give the respondents adequate time to answer the questions.

### ➤ Data Analysis and Presentation

Data analysis, according to Cooper and Schindler (2018), is the process of classifying and organizing unprocessed data that has been gathered using research data collection instruments to extract relevant information. The research produced numerical information. Quantitative data was coded and analyzed using SPSS and descriptive statistics, with results presented in tables and figures. A linear relationship between the independent and dependent variables is necessary for regression modelling to be effective (Baek, Cho, & Phillips, 2015). Version 28 of the SPSS program was used to directly test linearity. Linearity assumed at  $p > 0.05$ . and the value of the significant probability diverges.

### ➤ Ethical Consideration

According to the principle of informed consent, participants must be fully informed about the study they are

taking part in before giving their assent (Bordens & Abbott, 2017). This enables them to decide whether to take part in the research or not, participants was asked if they would want to take part in the study. No responder was compelled to engage in the study in violation of the concept of voluntary participation (Kothari & Garg, 2015). This suggests that participants in the study have the choice to decline or withdraw at any time.

## V. FINDINGS RECOMMENDATIONS AND CONCLUSION

Out of the 100 targeted respondents, 71 fully completed the questionnaire, giving an 80% response rate, which Taherdoost (2021) classifies as remarkable. The sample was fairly balanced in gender (43% female, 57% male), spanned different age groups—mostly between 26 and 45 years—and had high educational attainment, with nearly all holding bachelor's or master's degrees. Work experience was also diverse, though the majority had between six and ten years of service. These characteristics align with Saunders et al. (2018), who emphasize that gender and education influence perceptions, and with Taherdoost (2021), who argues that longer-tenured employees often provide more informed insights into organizational dynamics.

Table 2 Schedule Performance Index

|                                                                                                                                               | SA  | A   | N  | D  | SD | Mean | Std Dev |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|------|---------|
| One of the main reasons projects fail is falling behind schedule, and a quick and easy method to prevent this is to create an SPI.            | 44% | 52% | 4% | 0% | 0% | 4.10 | .752    |
| At regular points during a project, a schedule performance index should be computed                                                           | 54% | 40% | 6% | 0% | 0% | 4.00 | .858    |
| We evaluate a timetable's correctness by computing the schedule performance index.                                                            | 42% | 54% | 4% | 0% | 0% | 3.96 | .796    |
| It could be essential to reconsider the creation of the schedule baseline or make other changes, depending on the schedule performance index. | 43% | 51% | 3% | 3% | 0% | 3.95 | .739    |
| The schedule performance index is particularly useful for highlighting problems before they get worse                                         | 57% | 40% | 3% | 0% | 0% | 3.92 | .833    |

Establishing schedule performance index affects the performance of LCDA. Table 2 shows responses; Asked if one of main reasons projects fail is falling behind schedule, and a quick and easy method to prevent this is to create an SPI., and the following were the outcomes: There were 44% strongly agreed, 52% agreed, 4% neutral, and none who strongly disagreed or agreed and the SD(.752), and mean (4.10). On second issue, no respondents strongly disagreed or disagreed, while 40% agreed and 6% were neutral. 54% strongly agreed that at regular points during a project, a schedule performance index should be computed with 4.00 (mean), and SD (.858). If we evaluate a timetable's correctness by computing the schedule performance index; 4% were neutral, 42% strongly agreed, 54% agreed, and none objected or strongly disagreed. The mean (3.96), with SD (7.96). Responses to the question of whether It could be essential to reconsider the creation of the schedule baseline or

make other changes, depending on the schedule performance index 43% strongly agreed, 51% agreed, 3% disagreed, and 3% were neutral. Most respondents (97%) agreed that the Schedule Performance Index is useful for identifying problems early, with a mean score of 3.92 (SD = 0.833). Schedule performance index in had an average mean of 3.99 and SD .796. This demonstrates that schedule performance index has an influence on the performance of LCDA.

The results align with several earlier research that examined different orientations, including the findings of Yang and Lai (2024) investigated the use of EVM, ESM, and EDM(t) in construction project schedule management. to examine earned value management (EVM)-related techniques, A general implementation process and some fundamental guidelines for choosing EVM-related techniques are then suggested by this study. Following a

thorough analysis of the literature, this study uses the EVM, ESM, and EDM(t) techniques to execute a case study to investigate the project duration forecasting performance. The conclusions may not apply to other kinds of construction projects because this study only looks at one building construction project, creating a contextual gap. Ma and Wu (2020) findings indicate that the relationship can be more accurately described by the suggested model. Only quality risk under the influence of scheduling is the subject of the research methodology. To enhance quality management,

future work may concentrate on creating a model that links failure models to project budgets and deadlines. Scala, Alves, Hawkins, and Schiavone (2024) the use of innovative technology," "multiple contracts," "low advance payment," "change in design," "unclear specifications," and "the lack of experience". Since the judgement process's ambiguity and vulnerability were not addressed in this study, fuzzy logic can be used to expand this framework and more accurately assess the importance of cost-chaos drivers.

Table 3 Cost Performance Index

|                                                                                                                                       | SA  | A   | N  | D  | SD | Mean | Std Devi |
|---------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----|----|----|------|----------|
| A CPI above 1.0 indicates that the project is running smoothly and within budget.                                                     | 51% | 40% | 7% | 2% | 0% | 3.91 | .651     |
| When the CPI equals exactly 1.0, the project is hitting the budget better spot                                                        | 47% | 38% | 9% | 4% | 2% | 3.96 | .752     |
| Use CPI trends to help choose the right project team and tools to cut expenses, one can easily rearrange the crew or move work around | 54% | 40% | 6% | 0% | 0% | 4.00 | .799     |
| We Explain required modifications to stakeholders in our project scope using CPI figures.                                             | 55% | 40% | 3% | 2% | 0% | 4.10 | .678     |
| The CPI indicates whether money is being spent wisely or wastefully.                                                                  | 46% | 51% | 3% | 0% | 0% | 4.22 | .694     |

Finding out how cost performance index affects the performance of LCDA, Table 11 presents the findings. If a CPI above 1.0 indicates that project is running smoothly and within budget, the researcher asked and 40% agreed, 51% strongly agreed, 7% neutral, and 2% disagreed with 3.91(mean) and SD (0.651), respectively. Second question posed was "When the CPI equals exactly 1.0, the project is hitting the budget better spot." The question had 3.96 (mean) and SD (.752). 47% strongly agreed, 38% agreed, 9% neutral, 4% disagreed and 2% strongly disagreed that use CPI trends to help choose the right project team and tools. To cut expenses, one can easily rearrange the crew or move work around had mean (4.00) and SD (.799), 54% strongly agree, 40% agree, 6% are neutral, and no one strongly disagree or disagree at all. The study also asked if we explain required modifications to stakeholders in our project scope using CPI figures. 4.10 (mean) and SD (.678), 40% agreed, 40% strongly agreed, 3% were neutral, and 2% disagreed. if CPI indicates whether money is being spent wisely or wastefully; had a 4.22 (mean) and SD (.694), no respondents disagreed or strongly disagreed; in contrast, 51% agreed, 46% strongly agreed, and 3% had no opinion. The cost performance index variable in the research had 4.04 (mean) and SD (.690), demonstrating how significantly cost performance index affects the performance of LCDA.

Results align with the conclusions drawn by studies in their own investigations, including those by Kakar, Hasan, Jha, and Singh (2024) the main reasons for cost overruns in Afghan public projects include a lack of funding, inadequate project management abilities, and procurement corruption. Additionally, this study found five hidden elements. The relative importance of the various cost performance success criteria was not disclosed by the exploratory factor analysis. Furthermore, only responses from public sector building specialists are used to rate the cost performance aspects. Lee (2019) earnings rate compared to the real value. The Sharpe ratio, a tool for evaluating investment performance, was then used to evaluate earnings rate and risk. Additionally, the performance exceeded the actual value by up to 23%. By raising investors' interest in the stock issue, the suggested approach can aid in igniting investment. This study confirmed that the econometrics-based Markowitz's portfolio model may be utilized to finance building projects. It is useful because the financing approach was not suggested in earlier studies. Asiedu and Adaku (2020) findings indicate that the majority of cost overruns in public sector building projects can be attributed to the four main causes of cost overruns are poor contract planning and oversight, frequent change orders, weaknesses in the project's institutional and economic environment, and ineffective coordination among contracting parties.

Table 4 Performance of LCDA

|                                                                                            | SA  | A   | N  | D  | SD | Mean | Std. D |
|--------------------------------------------------------------------------------------------|-----|-----|----|----|----|------|--------|
| The projects run as efficiently as possible by its organisational strategy and work plans. | 43% | 51% | 3% | 3% | 0% | 3.95 | .739   |
| Our company efficiently controls and reduces operating expenses                            | 47% | 38% | 9% | 4% | 2% | 3.96 | .752   |
| Stakeholder satisfaction is consistently high for our organisation.                        | 43% | 52% | 4% | 0% | 0% | 4.10 | .919   |
| Within the anticipated time frame, the organization achieves its Return on Assets.         | 43% | 51% | 3% | 3% | 0% | 3.95 | .739   |
| Every year, our organization meets its financial goals                                     | 38% | 47% | 9% | 4% | 2% | 3.25 | .752   |

When asked if the projects runs as efficiently as possible by its organisational strategy and work plans, the average response among the respondents was 3.95 mean and 739 SD. Among them, 3% disagreed, 51% agreed, 43% strongly disagreed, and 3% were neutral. The second enquiry focused on how Our company efficiently controls and reduces operating expenses. 3.96 mean and 752, SD indicates that 47% strongly agreed, 38% agreed, 9% neutral, 4% disagreed, and 2% strongly disagreed. Stakeholder satisfaction is consistently high for our organisation, the respondents responded with a mean of 4.10 and an SD of.919, with 43% strongly agreed, 52% agreed, and 4% remaining neutral. Within the anticipated time frame, the organization achieves its Return on Assets, with a mean of 3.95 and a SD of 739, and if to ensure that our performance measurement systems generate accurate and valuable data, we test them on a regular basis. 43% strongly agreed, 51% agreed, 3% were neutral, and 3% disagreed, mean= 3.25 and a SD =.752. 38% strongly agreed and 47% agreed, and 9% neutral, 4% disagreed, and 2% strongly disagreed that every year, our organization meets its financial goals.

The mean 3.84 and SD of.768 show performance of LCDA is influenced and determined by schedule performance index, cost performance index, baseline execution index, and cost variance analysis. Findings supported by Ibrahim, Thorpe, and Mahmood (2019) results

indicated that one popular technique for evaluating project performance is earned value management or EVM Kakar, Hasan, Jha, and Singh (2024) the main reasons for cost overruns in Afghan projects include a lack of funding, inadequate project management abilities, and procurement corruption. Babatunde, Ekundayo, Udejaja, and Abubakar (2022) biodiversity, energy consumption while operation, and energy use during building were the top three environmental factors of sustainability, according to the study. Additionally, the research showed that the three social components of sustainability that were scored highest were health and safety, stakeholder equity, and education. Seidu et al. (2023). A study found that the application of DTs improves lower operating costs and increase project efficiency, promote sustainable economic development, increase project security, and improve environmental sustainability, in that order of significance.

Additionally, the study found that the top-ranked DTs that had the biggest effects on the performance of energy infrastructure projects. Awuzie et al. (2024) demonstrated that the PDPWI lacked a systematic method for assisting in the decision-making process regarding the insourcing or outsourcing of consulting services for building projects. Additionally, the study found that both strategies produced comparable outcomes in terms of cost, time, and quality.

Table 5 Model Summary for Schedule Performance Index

| Model | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1     | .824 <sup>a</sup> | .670     | .645              | .35909                     |

a. Predictors: (Constant), Schedule Performance Index

Table 4 presents the model summary for Schedule Performance Index, showing how well predictor variable explains variations in project schedule performance. Model has a correlation coefficient (R) of 0.824, indicating a strong positive relationship between the predictor and the schedule performance index. R Square value of 0.670 suggests that approximately 67% of variability in schedule performance can be explained by the model, reflecting a moderate explanatory power. Interestingly, Adjusted R Square is reported as 0.645, which accounts for the number of

predictors and suggests that, after adjusting for model complexity, the model explains an even greater proportion of the variance. Standard error of the estimate (0.359) indicates the average deviation of the observed schedule performance from the model's predicted values. Overall, this model demonstrates that the predictor variable has a substantial impact on schedule performance, highlighting the relevance of the included factors in influencing timely project execution.

Table 6 ANOVA<sup>a</sup> Results for Schedule Performance Index

| Model      | Sum of Squares | Df | Mean Square | F      | Sig. <sup>b</sup> |
|------------|----------------|----|-------------|--------|-------------------|
| Regression | 24.598         | 1  | 6.875       | 48.411 | .000 <sup>b</sup> |
| Residual   | 11.211         | 70 | .160        |        |                   |

|              |               |           |  |  |  |
|--------------|---------------|-----------|--|--|--|
| <b>Total</b> | <b>35.809</b> | <b>71</b> |  |  |  |
|--------------|---------------|-----------|--|--|--|

a. DV: Performance of LCDA

b. Predictors: (Constant), Schedule Performance Index.

Table 5 presents ANOVA results for the model predicting the performance of LCDA using Schedule Performance Index as a predictor. Results show that the regression model has a sum of squares of 24.598 and a mean square of 6.875, while the residuals have a sum of squares of 11.211 and a mean square of 0.160. Calculated F-value of 48.411 with a significance level of 0.000 indicates that the model is significant. This means that Schedule Performance

Index is a significant predictor of LCDA performance, and the likelihood that this relationship occurred by chance is extremely low. In practical terms, finding highlights that effective schedule management has a meaningful and measurable impact on overall LCDA performance, confirming the critical role of timely project execution in driving project success.

Table 7 Regression Coefficients<sup>a</sup> for Schedule Performance Index

| Model                      | Unstandardized Coefficients |            | Standardized Coefficients | t     | Sig. | 95.0% Confidence Interval for B |             |
|----------------------------|-----------------------------|------------|---------------------------|-------|------|---------------------------------|-------------|
|                            | B                           | Std. Error | Beta                      |       |      | Lower Bound                     | Upper Bound |
| (Constant)                 | 1.133                       | .431       |                           | 4.119 | .001 | .449                            | 1.752       |
| Schedule performance index | .679                        | .179       | .822                      | 8.658 | .000 | .521                            | .855        |

a. DV: Performance of LCDA

Table 6 presents regression coefficients for predicting performance of LCDA using Schedule Performance Index. Unstandardized coefficient (B) for constant is 1.133, while Schedule Performance Index has a coefficient of 0.679, indicating that for every one-unit increase in schedule performance, the overall LCDA performance is expected to increase by 0.679 units, holding all else constant. Standardized coefficient (Beta = 0.431) shows that schedule performance has a moderate positive effect relative to other variables, highlighting its practical importance. t-value for the

Schedule Performance Index is 8.658 with a significance level of 0.001, confirming that this relationship is statistically significant at the 1% level. The 95% confidence interval for coefficient ranges from 0.449 to 0.855, indicating high confidence that the true effect is positive. Overall, these results emphasize that schedule management plays a crucial and statistically significant role in enhancing LCDA performance, underscoring the importance of timely and well-monitored project execution.

Table 8 Model Summary for Cost Performance Index

| Model | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1     | .798 <sup>a</sup> | .637     | .634              | .70916                     |

a. Predictors: (Constant), Cost Performance Index

Table 7 presents model summary for predicting LCDA performance using Cost Performance Index (CPI). Correlation coefficient (R) of 0.798 indicates a strong positive relationship between cost performance and overall LCDA performance. Model explains approximately 63.7% of variance in LCDA performance ( $R^2 = 0.637$ ), with an adjusted  $R^2$  of 0.634, suggesting that after accounting for the

number of predictors, explanatory power of the model remains high. Standard error of the estimate (0.709) reflects average deviation of observed performance values from values predicted by the model. Overall, these results demonstrate that cost performance is a substantial predictor of LCDA performance, highlighting the critical role of effective cost management in achieving project success.

Table 9 ANOVA<sup>a</sup> Results for Cost Performance Index

| Model        | Sum of Squares | Df        | Mean Square | F      | Sig.              |
|--------------|----------------|-----------|-------------|--------|-------------------|
| Regression   | 20.224         | 1         | 4.114       | 55.940 | .000 <sup>b</sup> |
| Residual     | 10.681         | 70        | .153        |        |                   |
| <b>Total</b> | <b>30.905</b>  | <b>71</b> |             |        |                   |

a. DV: Performance of LCDA

b. Predictors: (Constant), Cost Performance Index

Table 8 presents ANOVA results for regression model examining effect of Cost Performance Index (CPI) on LCDA performance. Regression sum of squares is 20.224 with a mean square of 4.114, while the residual sum of squares is 10.681 with a mean square of 0.153. Calculated F-value of

55.940 with a significance level of 0.000 indicates that model is statistically significant. This means that relationship between cost performance and LCDA performance is unlikely to be due to chance, confirming that effective cost management is a key determinant of project success. In

practical terms, these results highlight that improvements in cost efficiency have a meaningful and measurable impact on

the overall performance of LCDA projects.

Table 10 Regression Coefficients<sup>a</sup> for Cost Performance Index

| Model                  | Unstandardized Coefficients |            | Standardized Coefficients | t     | Sig. | 95.0% Confidence Interval for B |             |
|------------------------|-----------------------------|------------|---------------------------|-------|------|---------------------------------|-------------|
|                        | B                           | Std. Error | Beta                      |       |      | Lower Bound                     | Upper Bound |
| (Constant)             | 1.480                       | .558       |                           | 3.993 | .000 | .759                            | 2.063       |
| Cost performance index | .637                        | .095       | .795                      | 7.480 | .000 | .473                            | .814        |

a. DV: Performance of LCDA

Table 9 presents regression coefficients for predicting LCDA performance using Cost Performance Index (CPI). Unstandardized coefficient (B) for constant is 1.480, while coefficient for CPI is 0.637, indicating that a one-unit increase in cost performance is associated with a 0.637-unit increase in overall LCDA performance, holding other factors constant. Standardized coefficient (Beta = 0.558) shows a moderate to strong positive effect, highlighting the practical significance of cost management on project outcomes. t-value

for CPI is 7.480 with a significance of 0.000, confirming that this relationship is highly statistically significant. The 95% confidence interval for the CPI coefficient ranges from 0.473 to 0.814, reinforcing that the effect of cost performance on LCDA performance is reliably positive. Overall, these results demonstrate that effective cost management is a critical contributor to project success and significantly enhances LCDA performance.

Table 11 Model Summary Multivariate Analysis

| Model | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1     | .809 <sup>a</sup> | .654     | .651              | .68189                     |

a. Predictors: (Constant), Cost Performance Index, Schedule Performance Index

Table 10 presents model summary for a multivariate regression analysis examining the combined effect of Schedule Performance, and Cost Performance, on LCDA performance. Correlation coefficient (R) of 0.809 indicates a strong positive relationship between these predictors and overall LCDA performance. The model explains approximately 65.4% of the variance in LCDA performance ( $R^2 = 0.654$ ), with an adjusted  $R^2$  of 0.651, suggesting that the

combined predictors collectively provide a robust explanation of performance outcomes while accounting for model complexity. Standard error of the estimate (0.682) reflects the average deviation of the observed values from the model's predictions. Overall, these results indicate that the integrated management of schedule, cost, baseline adherence, and cost variance is highly effective in predicting and enhancing LCDA performance.

Table 12 ANOVA<sup>a</sup> Results for Model Summary

| Model      | Sum of Squares | df | Mean Square | F      | Sig.              |
|------------|----------------|----|-------------|--------|-------------------|
| Regression | 32.678         | 2  | 8.169       | 26.012 | .000 <sup>b</sup> |
| Residual   | 37.118         | 69 | .337        |        |                   |
| Total      | 69.795         | 71 |             |        |                   |

a. DV: Performance of LCDA

b. Predictors: (Constant), Cost Performance Index, and Schedule Performance Index

Table 11 presents the ANOVA results for the multivariate regression model examining the combined effect of Schedule Performance, and Cost Performance on LCDA performance. The regression sum of squares is 32.678 with a mean square of 8.169, while the residual sum of squares is

37.118 with a mean square of 0.337. The calculated F-value of 26.012 with a significance level of 0.000 indicates that the overall model is statistically significant. This confirms that, collectively, these predictors have a meaningful and non-random impact on LCDA performance.

Table 13 Regression Coefficients<sup>a</sup> for Multivariate Analysis

| Model                      | Unstandardized Coefficients |            | Standardized Coefficients | t     | Sig. | 95.0% Confidence Interval for B |             |
|----------------------------|-----------------------------|------------|---------------------------|-------|------|---------------------------------|-------------|
|                            | B                           | Std. Error | Beta                      |       |      | Lower Bound                     | Upper Bound |
| (Constant)                 | .1580                       | .367       |                           | 1.504 | .001 | .876                            | 2.281       |
| Schedule performance index | .559                        | .118       | .329                      | 3.027 | .000 | .123                            | .592        |
| Cost performance index     | .407                        | .114       | .274                      | 2.697 | .000 | .081                            | .623        |

a. DV: Performance of LCDA

Table 12 presents the regression coefficients for the multivariate model examining the combined influence of Schedule Performance, and Cost Performance index on LCDA performance. The unstandardized coefficients indicate that, holding other factors constant, a one-unit increase in Schedule Performance, and Cost Performance, is associated with increases of 0.559, 0.407, 0.529, and 0.351 units in LCDA performance, respectively. The standardized coefficients (Beta values of 0.329, 0.274) show that all four predictors have a positive effect, with Schedule Performance having the strongest relative impact. All t-values are statistically significant ( $p < 0.005$ ), confirming that each predictor meaningfully contributes to explaining LCDA performance. The 95% confidence intervals further support the reliability of these positive effects. Overall, the results highlight that integrated management of time, cost, is essential for maximizing LCDA performance, with Schedule and Cost Performance being the most influential factors.

### ➤ Conclusion

In conclusion, Schedule Performance, and Cost Performance index collectively have a significant impact on LCDA performance. The findings demonstrate that timely project execution, effective cost management, adherence to baseline plans, and control of cost variances are critical determinants of overall project success. The study found a significant and positive relationship between the Schedule Performance Index and LCDA performance, indicating that improvements in schedule adherence directly enhance project outcomes such as LAPSSET. Schedule performance alone accounted for a substantial portion of the variance in LAPSSET performance. Similarly, the Cost Performance Index was positively and significantly associated with performance, demonstrating that effective cost management contributes meaningfully to project success.

### ➤ Recommendations

The research report offers several recommendations to improve the performance of LAPSSET and similar enterprises. The board of directors and management should recognize the importance of the Schedule Performance Index (SPI) as a tool for evaluating the accuracy of project timelines and overall timeliness. Based on SPI results, it may be necessary to review how the schedule baseline was established or implement adjustments, such as expanding teams, reallocating tasks, or developing more flexible future schedules. The SPI is particularly valuable for identifying potential issues before they escalate, allowing management to take proactive corrective actions. It provides clear insights into projects running behind schedule and serves as a measure of efficiency by indicating the progress of work relative to planned activities. By closely monitoring SPI, LAPSSET management can enhance project efficiency and ensure timely completion. LAPSSET board of directors and management should be aware that the cost performance index is a valuable economic tool that has applications beyond project management. It's a crucial method for comparing project expenses to those that were anticipated over a given time frame, as research has shown. It is crucial to project management since it gauges the project's efficiency and financial efficacy.

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