

## **The Impact of AI Adoption on Project Scheduling Efficiency in Real Estate Development Projects in Nairobi**

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### **ABSTRACT**

*The adoption of Artificial Intelligence (AI) and Machine Learning (ML) technologies in real estate project management has resulted to the enhancement of project scheduling efficiency. As such, this study investigated how AI has enhanced the optimization of project schedules within the real estate sector in the Nairobi Metropolitan Area. A mixed research method approach was employed in which the research integrated qualitative data collected through interviews with project managers and quantitative data obtained from project records to evaluate the impact of AI on key scheduling metric. The metrics include Schedule Performance Index (SPI) and the Critical Path Length Index (CPLI). The findings of this study reveal that the adoption of AI can lead to tremendous improvements in scheduling efficiency hence leading to a reduction in project delays and thus leading to effective schedule adjustments. AI tools have also proven to contribute to better resource allocation and cost control which leads to smoother project execution. However, the adoption of AI still face challenges such as high implementation costs, data privacy concerns, and a shortage of skilled personnel. Therefore, this study concludes that while AI offers a greater potential in the enhancement of project scheduling, it is still worth addressing the identified challenges to be able to maximize its benefits. This study recommends that real estate companies should invest in AI training amongst its staff and also a cost-effective AI solutions for smaller firms should be developed to benefit all stake holders in the real estate field. There should also be a robust implementation of data privacy policies to improve the security of those using AI in managing their projects.*

**Keywords:** Artificial Intelligence, Machine Learning, Project Scheduling Efficiency, Real Estate Development, Nairobi, Critical Path, Schedule Performance Index

## **1. Introduction**

### **1.1. Background of the Study**

Project scheduling is a critical component in the real estate and construction sectors as it enhances effective project management. It is very important to ensure that real estate tasks are completed on time and that the relevant resources are optimally allocated. This may involve better way of controlling the cost of projects. In Nairobi's real estate sector, project delays and cost overruns have become a major challenge amongst project managers and they are often linked to inefficient scheduling processes. The traditional manual scheduling methods are prone to inaccuracies which often results to budget overruns and missed deadline.

AI and ML offers transformative solutions to the many challenges faced by real estate project managers, and especially those associated with project scheduling. As such, AI has been proven to optimize project scheduling by automating task sequencing and predicting potential delays. It has also proven to enabling real-time adjustments based on project data. AI has tools such as predictive analytics tools which can improve accuracy and efficiency in project scheduling which significantly reduces the likelihood of project delays. When AI is integrated into project management platforms like Primavera and Microsoft Project, it can lead to enhanced schedule adherence, resource optimization, and risk mitigation (Nath, 2021; Alzoubi, 2022).

### **1.2. Problem Statement**

Nairobi Metropolitan Area's real estate sector continues to face challenges related to inefficient project scheduling despite being the fastest growing sector in the region. This challenge has led to frequent project delays and cost escalations. AI has the capacity to address these challenges, but its adoption in Nairobi's real estate sector remains limited. This study examines the extent to which the adoption of AI can improve project scheduling efficiency in real estate projects in the Nairobi Metropolitan Area, with a focus on key metrics such as the Schedule Performance Index (SPI) and the Critical Path Length Index (CPLI).

### **1.3. Research Objectives**

The main objective of this study is to assess the role of AI adoption on project scheduling efficiency in real estate development projects in the Nairobi Metropolitan Area. These objectives include:

1. To evaluate how the adoption of AI impacts the Schedule Performance Index (SPI) in real estate projects in Nairobi Metropolitan Area.
2. To assess the influence of AI on the Critical Path Length Index (CPLI) in real estate

projects in Nairobi Metropolitan Area.

3. To identify the challenges faced by real estate firms in Nairobi Metropolitan Area in adopting AI for project scheduling.

#### **1.4. Research Questions**

1. To what extent does the adoption of AI improve the Schedule Performance Index (SPI) in real estate projects?
2. How does the adoption of AI influence the Critical Path Length Index (CPLI) in real estate projects?
3. What are the major challenges faced when working with AI project scheduling tools in Nairobi's real estate sector?

#### **1.5. Justification of the Study**

This study aims at providing an overview of the potential benefits of adopting AI for the purposes of improving project scheduling in Nairobi's real estate sector. Given the increasing complexity of real estate projects, particularly in major cities like Nairobi, AI has proven its ability to offer a means of addressing scheduling challenges. This has been solely possible by the automation of routine tasks and the provision of predictive analytics which improve scheduling accuracy. The results of this study will help stakeholders to better understand AI and its tools and how the latter can be leveraged to enhance project performance by reducing delays, and optimizing resource allocation. Furthermore, this study highlights the challenges that must be addressed to encourage broader adoption of AI in the real estate sector in Nairobi Metropolitan Area (Abioye et al., 2021; Chauhan et al., 2021).

## **2. Literature Review**

### **2.1. Project Scheduling Efficiency**

Project scheduling involves organizing tasks, allocating resources, and establishing timelines to ensure projects are completed within the specified time frame. Efficiency in project scheduling is often measured by two major metrics which are Schedule Performance Index (SPI) and the Critical Path Length Index (CPLI). SPI measures the ratio of work done to work planned, while CPLI evaluates the flexibility in project timelines. An SPI value of 1.0 indicates that a project is on schedule, while a CPLI value greater than 1.0 indicates more flexibility in managing timelines (Panch et al., 2018; He et al., 2020).

AI tools can improve project scheduling efficiency by automating task sequencing and predicting

potential bottlenecks. Project scheduling efficiency can also be improved by providing real-time schedule adjustments. For example, AI algorithms can be used to analyze historical project data and identify patterns that can be helpful in forecasting future scheduling challenges, thereby allowing project managers to proactively mitigate risks (Zhang et al., 2021).

## **2.2. AI in Project Management**

AI technologies have revolutionized project management by offering solutions to complex problems such as resource allocation, task prioritization, and risk management. As such, AI-based algorithms can process large datasets and optimize project schedules by identifying the most efficient sequence of tasks, forecasting delays, and suggesting mitigation strategies. In real estate projects, AI tools have been successfully used in streamlining scheduling processes, allowing for dynamic adjustments in response to real-time data (Chui et al., 2020).

AI can also enhance resource allocation by predicting the availability of labor, materials, and equipment needed to complete a project, and also can be useful in the adjustment of project timelines according to the factors mentioned earlier. This flexibility helps project managers in handling any unexpected changes in resource availability without significantly affecting the overall project timeline (Alzoubi, 2022).

## **2.3. Empirical Evidence on AI Adoption**

Empirical studies have demonstrated the positive impact of AI adoption in real estate on project scheduling. For instance, research has proven that AI-driven projects are completed more efficiently, with fewer delays and better resource management as compared to projects done using the traditional scheduling methods. As such, a finding by Wangila (2018) postulates that real estate projects conducted by the help of AI tools are able to reduce delays by 30%, as compared to those managed without AI. However, Dokata explains that the adoption of AI in Nairobi's real estate sector is still limited due to challenges such as high costs, a lack of skilled personnel, and data privacy concerns (Dokata, 2017).

## **3. Research Methodology**

### **3.1. Research Design**

This research adopted a mixed-methods approach, which combines both qualitative and quantitative data collection techniques. The qualitative data technique involved semi-structured interviews with project managers from different real estate firms in Nairobi. These interviews were aimed to gather insights into their experiences with AI adoption in project scheduling in their projects. The quantitative technique employed herein was used to analyze data from seven

real estate projects that have implemented AI tools to evaluate their scheduling performance.

### **3.2. Target Population**

The target population for this study included project managers from real estate development firms in the Nairobi Metropolitan Area. These firms include Mi Vida Homes, Knight Frank, and Centum Investment Limited, which manage a range of residential and commercial real estate projects. Data collected from these firms provide a comprehensive perspective on AI adoption in different types of real estate developments in Nairobi Metropolitan Area and in Kenya at large considering they are involved in the development of the major real-estate projects in Kenya and across the East African region.

### **3.3. Data Collection**

Data collection was conducted in two phases which are:

- 1. Qualitative Interviews:** Semi-structured interviews were conducted with seven project managers, focusing on their experiences with the adoption of AI in project scheduling. The interviews explored the perceived benefits of AI, the challenges encountered during its implementation, and the suggestions they would give to improve AI to make it reliable in the real-estate sector.
- 2. Quantitative Data Analysis:** Data collected from different project records, including scheduling performance, resource utilization, and cost management, were collected from the seven real estate projects and then key metrics such as the Schedule Performance Index (SPI), Critical Path Length Index (CPLI), and on-time completion rates were analyzed. This was for the purposes of assessing the impact of AI on project scheduling efficiency.

### **3.4. Data Analysis**

Quantitative data was analyzed using descriptive statistics. This was through metrics outlined earlier, which are the SPI and CPLI. On-time completion rates were also compared across AI-driven and non-AI-driven projects to evaluate the impact of AI on scheduling efficiency.

Qualitative data from the interviews was analyzed thematically to identify recurring themes related to AI adoption, such as implementation challenges, perceived benefits as per the views of the project managers, and areas for improvement they think need improvement to make it more dependable and secure to use.

## 4. Data Presentation and Analysis

### 4.1. Impact of AI Adoption on Project Scheduling Efficiency

The results of this study indicate that the adoption of AI has a positive impact on project scheduling efficiency in real estate projects. **Table 1** below provides an overview of the key scheduling metrics. It shows that the projects done using AI tools achieved better SPI and CPLI values than those that did not use AI.

**Table 1: Impact of AI Adoption on project scheduling efficiency**

Variable	Indicators	Results	Mean	Standard Deviation
Project Scheduling Efficiency	Schedule Performance Index (SPI)	0.95 (Slightly behind schedule)	0.95	0.05
	Critical Path Length Index (CPLI)	1.1 (Some schedule flexibility)	1.10	0.10
	On-Time Completion Percentage	72% of projects completed on time	72.00%	5.00%
	Number of Schedule Adjustments	Average of 3 adjustments per project	3.00	1.00

The table also shows that projects done by the support of AI had an average SPI of 0.95, indicating that the projects were only slightly behind schedule, compared to non-AI projects. The information also proves that AI tools also contributed to a higher CPLI (1.1), suggesting greater flexibility in managing the critical path. On-time completion rates were significantly higher in AI-driven projects by (72%) as compared to projects that did not utilize AI tools in their scheduling and management. Additionally, the average number of schedule adjustments in AI-driven projects was found to be lower, averaging three adjustments per project.

### 4.2. Challenges in AI Adoption

Despite the improvements in scheduling efficiency, several challenges were identified in adopting AI tools in real estate projects. The table below outlines the primary challenges faced

by different real-estate firms while implementing AI in Nairobi Metropolitan Area's real estate sector.

**Table 2: AI Adoption and Challenges in Real Estate Projects**

<b>Variable</b>	<b>Indicators</b>	<b>Results</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>AI Adoption Rate</b>	Percentage of projects using AI	70% of projects	70.00%	8.00%
<b>Data Privacy Concerns</b>	High level of concern	High	-	-
<b>Implementation Costs</b>	High initial investment	High	-	-
<b>Skilled Personnel Shortage</b>	Availability of trained AI personnel	Moderate	-	-

According to the table above, it is evident that although 70% of the real estate firms are willing or have adopted AI tools, the project managers have concerns regarding the data privacy of their companies. There are also high costs involved in the implementation of AI tools in real-estate projects, and the labor market is also short-staffed of skilled personnel who can work and operate the available real-estate tools. The high upfront investment required for AI tools limits their adoption, particularly for smaller firms. Data privacy concerns, especially related to cloud-based AI platforms, are so eminent that project managers are afraid to fully adopt AI tools.

### **4.3. Resource Allocation Efficiency in AI-Driven Projects**

AI tools have significantly improved resource allocation efficiency in real estate projects. The table below highlights how AI-driven projects achieved better resource utilization and fewer conflicts in resource allocation compared to non-AI projects.

**Table 3: Resource Allocation Accuracy in AI-Driven Projects**

Variable	Indicators	Results	Mean	Standard Deviation
Resource Allocation Accuracy	Resource Utilization Rate	85% (Efficient resource use)	85.00%	7.00%
	Resource Capacity	90% of capacity utilized	90.00%	5.00%
	Number of Resource Conflicts	50% fewer conflicts in AI projects	-	-
	Number of Resource Changes	Fewer changes in AI-driven projects	-	-

The data presented on the table shows that AI-driven projects achieved a higher resource utilization rate of (85%) as compared to non-AI projects. Moreover, the capacity utilization rate of AI driven projects was higher at (90%), with 50% fewer resource conflicts reported in AI-driven projects. These improvements resulted in fewer resource changes and a more streamlined project execution process.

## 5. Conclusion and Recommendations

### 5.1. Summary of Findings

This study has demonstrated that the adoption of AI has lead to significant improvements in project scheduling efficiency in the real estate sector and hence, the Nairobi Metropolitan Area has a greater potential when it comes to the utilization of AI in project scheduling efficienc if it ultimately adopts AI fully in managing its projects. As such, AI tools enhanced the Schedule Performance Index (SPI) and the Critical Path Length Index (CPLI), which results in better adherence to project timelines and increased flexibility in managing critical tasks. Moreover, AI



contributed to more efficient resource allocation, with fewer conflicts and higher resource utilization rates. Despite these benefits, this study identified several challenges, which include the high implementation costs that are tied to the acquisition of AI systems, data privacy concerns which is a major concern in all the web-based systems, and a shortage of skilled personnel since AI is an emerging technologies and not everyone is well equipped to work with it.

## **5.2. Recommendations**

For the real estate sector in Nairobi Metropolitan region to fully capitalize on the potential of AI in improving project scheduling, several actions need to be taken. Firstly, real estate firms should invest in comprehensive AI training programs for their project managers and technical staff.

Hence, by equipping their teams with the necessary skills to effectively use AI tools, real-estate firms can enhance their ability to manage project timelines, allocate resources more efficiently, and mitigate risks in real time. It is also essential for real-estate firms address the concerns surrounding data privacy, particularly in the context of cloud-based AI systems. By implementing robust data privacy policies and using secure AI systems, real-estate firms will alleviate some of the apprehensions that project managers and stakeholders have regarding the safety of sensitive project data. Furthermore, real-estate firms should explore cost-effective AI solutions, especially smaller firms that might find the high initial investment prohibitive. Open-source AI platforms and other affordable tools can provide these companies with the opportunity to adopt AI technologies without incurring prohibitive costs. Finally, the creation of industry-wide AI adoption standards, focusing on best practices for implementation, could help streamline the integration of AI across Nairobi Metropolitan Area's real estate sector, making the benefits of AI more accessible to all firms, regardless of size.

## **5.3. Suggestions for Further Study**

Further research should focus on the long-term impact of AI on project cost control and the overall project quality. Comparative studies across different sectors, such as infrastructure and commercial real estate, could provide additional insights into how the adoption of AI varies depending on the type of project being handled. Additionally, further exploration of the integration of AI with other emerging technologies, such as Building Information Modeling (BIM) and the Internet of Things (IoT), could reveal new opportunities for optimizing project management processes.

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