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## Extensive research on the multiple ways in which drones are employed in the field of construction management

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### ABSTRACT

*Drone technology has made its way into various sectors, including the construction industry. By utilizing drone technology, project manager can enhance their communication and improve project efficiency. This study aims to delve into the potential of drones in construction and shed light on the benefits and impacts of this emerging trend into construction management. Employing the lidar technology, this review article analyses existing knowledge in the field and examines the effects of drone usage in the construction industry. Additionally, the article explores the advantages of incorporating drones into construction projects, taking into account various dimensions of Project management. To fulfill the research objective, a thorough analysis is conducted to uncover the wide-ranging applications of drones throughout the construction project lifecycle. This analysis not only entails identifying the benefits, challenges, and costs associated with their usage but also delving into the considerations that need to be taken into careful account.*

**Keywords:** Drone technology, Unmanned Aerial Vehicle (UAV), lidar drone technology, Construction technology trends, and construction stages, project management, 3d modeling.

### 1. INTRODUCTION

With immense development and contemporary technological progressions, the application of Unmanned Aerial Vehicles (UAVs) proceeds to remodel diverse industries and fields. The introduction of smart Drone-Powered solutions and the implementation of scientific instruments, enterprises have given a distinct denomination to traditional surveying and safety inspections of assets. Construction site monitoring and planning is a crucial sector that employs UAVs for enhanced performance, velocity, and precision of information. Exhibiting opportunities for extensive uses of drones, in this paper we study the numerous construction project steps such as **pre-planning, comprehensive surveying, 3D mapping, construction process monitoring, quality monitoring, safety inspections, marketing**, etc.

In the world of the ever-growing construction site industry, planners and architects often employ drones as a real-time tool to observe their progress and if it corresponds with their vision and imagination. The information acquired also encourages developers and construction site businesses to track their inventory. This blog vividly explains how drones and Unmanned Aerial Vehicles (UAVs) have molded the construction industry with intelligent construction site monitoring and reporting systems supported by real-time data. UAV, especially in the construction industry, have transformed the sector towards enhanced efficiency and accuracy. In this study we often map the job-site every week, employing UAVs or drones. Routine surveying is fundamental for tracing development, safety inspections, and real-time quality monitoring. Drones allow to get a bird-eye-view on the entire project and reveal concerns that would be impossible at ground level inspections. Geotagging capabilities of drone maps enable the capture of necessary area measurement and transform it into an estimated stockpile volume for quick, reliable decision-making.



Figure 1 Aerial image of construction site in Pune Maharashtra taking by (matrice 300 rtk) drone.

In addition to data collection, LiDAR drones can also be used for construction site monitoring and management. By using LiDAR drones to capture aerial footage of the site, project managers can track progress and identify any issues that may arise. LiDAR drones can also be used to create 3D models of the site, allowing project managers to visualize the project in greater detail and make more informed decisions.

### **Aim**

In-detail study conducted to assess the diverse ways in which drone are utilized in different sector and phases of construction management.

### **Objective**

- To find out the efficiency of drone technology in construction management field.
- To explore the application of drone in various phases of construction project.
- To analysis the impact of lidar drone technology in construction project.

### **Future Scope of study**

- Drones can be used on a regular basis in the construction industry, encompassing all well-known applications of this technology.
- For embracing the user - friendly nature of this drone application.
- A comprehensive guide to utilizing drone in various stages of construction for optimal result.
- Opportunity to learn about the ways in which project managers can enhance project ROI through the utilization of drone technology

### **Limitations of study**

1. Skilled drone operator on the construction site is essential.
2. Availability of proper drone selection based on the site's needs.
3. The operational efficiency of drones can be influenced by the weather conditions at the construction site
4. The maintenance of the drone is being taken care of.
5. Data generation from drone data required software.

## **II. EXPLORING THE APPLICATIONS OF DRONES AT EVERY STAGE OF A PROJECT**

Throughout the entire project lifecycle, drones can play a crucial role. They can be effectively utilized from the early stages of pre-planning and design, all the way through the construction phase, and even during the later stages of asset management, operation, and overall project management. This section provides an in-depth exploration of the major applications of drones across the different phases of a construction project. Although there is no universally agreed definition of a construction project's lifecycle, this paper adopts the commonly referenced preconstruction phase, construction phase, and postconstruction phase.

### **Study Area**

We would like to acknowledge the ongoing construction site in Pune and highlight our use of a drone to effectively accomplish the objectives of this study. The *Rohan Ishan project* site has been chosen as the primary location for the overall project, with help of *AM DATA LAB PVT LTD* drone agency we conducting a drone survey utilizing the *DJI Mavic 3 Pro* and *Matrice 300 RTK*. This strategic approach aims to successfully achieve the desired outcomes of this project. Analyzing following three phases (preconstruction phase, construction phase, postconstruction phase) with help of drone.

The subsequent report has been collected from a drone agency of high credibility. It outlines the percentage of drone utilization at a *Rohan Ishan* site during different stages of construction.











PHASE	ACTION	DRONE INVOLVMENT	DRONE PRODUCTS	APPLICABILITY OF UAV TECHNOLOGY	POTENTIAL IMPACT ON PROCESS EFFICIENCY
<b>PRE- CONSTRUCTION</b>					
PLANNING AND DESIGN	<u>PROJECT CONCEPT</u>	—	—	—	—
	<u>PROJECT DESIGN</u>	Generating high resolution maps to better align the project with environmental conditions.	Orthophoto DSM, 3D model		 50%
LAND PURCHASE	<u>VALIDATION OF LAND COORDINATES</u>	The use of drones serves to verify plot boundaries, especially in countries where accurate records are lacking.	Orthophoto		 50%
	<u>VERIFICATION OF SUITABILITY FOR PROJECT CONCEPT</u>	UAVs may help to spot issues, which might not be seen from ground level or in available documentation.	Orthophoto3D model		 20%
BUILDING PERMITS	<u>SECURING ALL REQUIRED PERMITS</u>	—	—	—	—
PREPARATION FOR CONSTRUCTION	<u>CALCULATING DEMAND FOR MATERIALS</u>	Estimation of earthworks and other operations related to preparation of the site for construction and subsequent usage.	DSM,3D models		 50%
	<u>ESTIMATING SCHEDULE OF WORK</u>	—	—	—	—
	<u>PROCUREMENT AND ASSEMBLING WORKFORCE</u>	Part of the operations can be augmented by drones, which allows a reduction in the number of workers needed for measuring and inspection tasks.			 80%

Table 1 Pre-construction activity















PHASE	ACTION	DRONE INVOLVMENT	DRONE PRODUCTS	APPLICABILITY OF UAV TECHNOLOGY	POTENTIAL IMPACT ON PROCESS EFFICIENCY
<b>CONSTRUCTION</b>					
PROGRESS MONITORING	<u>EARTHWORK STAGE</u>	Precise earthwork volume calculations, preparing accurate data for machine steering systems. Verification that works are carried out to plan and in accordance with the schedule.	Orthophoto DSM, 3D model		 90%
	<u>CONSTRUCTION WORKS</u>	Detection of errors and comparing photogrammetry output with digital project plans. Verification that works are carried out to plan and in accordance with the schedule.	Orthophoto3D model		 80%
	<u>FINISHING WORKS</u>	The use of drones serves to verify plot boundaries, especially in countries where accurate records are lacking.	Orthophoto3D model		 80%
	<u>PAYMENT RELEASE</u>	UAVs may help to spot issues, which might not be seen from ground level or in available documentation.	Orthophoto,3D models, Video & photo		 50%
BUILDING PERMITS	<u>LOCATING HAZARDS ON SITE</u>	3D overview of the site from UAS enables identification of higher-risk areas, allowing countermeasures to be put in place.	Video & photo,3d model		 50%
	<u>MONITORING WORKERS' COMPLIANCE WITH SAFETY STANDARDS</u>	Drones can identify workers breaking safety standards—the mere use of technology to pursue enforcement is enough of a deterrent/encouragement for most.	Video & photo		 20%

Table 2 Construction activity

PHASE	ACTION	DRONE INVOLVMENT	DRONE PRODUCTS	APPLICABILITY OF UAV TECHNOLOGY	POTENTIAL IMPACT ON PROCESS EFFICIENCY
<b>POST-CONSTRUCTION</b>					
MAINTENANCE	<u>STRUCTURE INSPECTIONS</u>	Providing detailed geometric, visual and structural condition information for numerous objects – which is especially useful in hard-to-reach places.	Point cloud,3D models, Video & photo		 50%







	<u>PREPARATION OF SITE FOR USE</u>	Verification that auxiliary infrastructure is located in accordance to plans. Aiding restoration of surrounding area to pre-construction condition.	Orthophoto,3D models		 90%
<b>CONSTRUCTION HANDOVER</b>					
TECHNICAL CONDITIONS	<u>PREPARATION OF AS-BUILT DOCUMENTATION</u>	Providing detailed geometric and visual data for the purpose of drawing up technical and legal documentation.	Point cloud ,3D models, Video & photo		 50%
LEGAL CONDITIONS	<u>VERIFICATION OF THE PROJECT'S ADHERENCE TO LEGAL REQUIREMENTS</u>	—	—	—	—

Table 3 post-construction activity

### III. USE OF LIDAR 3D MODEL (MATIC 300 RTK)

To achieve superior results, we are employing the Lidar Drone Matrics 300 RTK for continuous site inspections. Making 3d model from drone data.

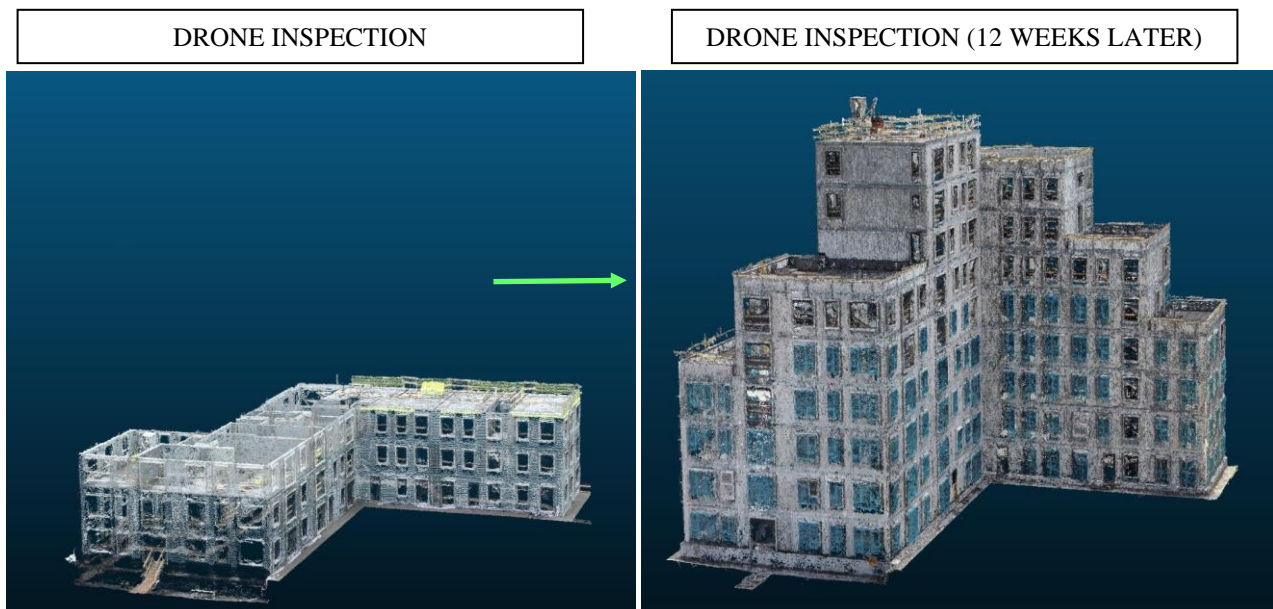


Figure 2 lidar 3d modeling of ROHAN ISHAN construction site of Pune Maharashtra taking by (matrice 300 rtk) drone.

### IV. METHODOLOGY

In pursuit of our research objective, we have established a collaboration with AM Data Lab Drone Agency. Subsequently, we have initiated the process of preparing a report on the selected site, encompassing different phases to assess the efficacy of drones in construction management. This study has yielded valuable insights and key findings.

mythology, is we follow for this research is as follow

- Choosing the appropriate location for the project site
- Cooperating with the Rohan Ishan project for collaboration
- Conducting a comprehensive survey to prepare for the drone implementation
- Selecting a suitable drone that meets the specific requirements of the site
- Deciding on the DJI Mavic & Matrics 300 RTK drone for the particular site
- Obtaining necessary permissions from the respective department for drone flying
- Hiring a skilled drone operator to be present on-site
- Deploying the drone effectively at the site
- Generating valuable outputs from the drone's data collection
- Ultimately, compiling a comprehensive report based on the findings

## **V. CONCLUSION**

This study encapsulated the extensive applications of drones in the construction industry, shedding light on their multifaceted role. It meticulously examined how drones can be effectively utilized at every stage of a construction project, offering valuable insights into their diverse functionalities. Moreover, the paper meticulously outlined the benefits that arise from the integration of drones in construction practices, while also acknowledging the obstacles that may arise. Additionally, it presented a thorough analysis of prevailing practices derived from successful drone implementations within the construction sector. The findings presented in this paper serve as a solid foundation for both scholars and practitioners in the construction field, providing a comprehensive understanding of the current landscape of drone usage.

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