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“A DETAILED INVESTIGATION HAS BEEN CONDUCTED TO EXPLORE THE VARIOUS WAYS IN WHICH DRONES ARE UTILIZED FOR EFFECTIVE CONSTRUCTION MANAGEMENT”

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Abstract: This study has been undertaken to investigate, the integration of drone technology in different sectors, including construction, has been a significant development. By harnessing the power of drones, project managers can greatly enhance communication and improve project efficiency. This study aims to thoroughly explore the potential of drones in construction and shed light on the numerous benefits and impacts of this emerging trend in construction management. Through the utilization of lidar technology, this review article carefully analyzes the existing knowledge in the field and examines the effects of drone usage in the construction industry. Furthermore, the article delves into the advantages of incorporating drones into construction projects, considering various dimensions of project management. To achieve the research objective, a comprehensive analysis is conducted to uncover the wide-ranging applications of drones throughout the construction project lifecycle. This analysis not only involves identifying the benefits, challenges, and costs associated with their usage but also delving into the considerations that require careful attention.

Index Terms - Drone technology, Unmanned Aerial Vehicle (UAV), lidar drone technology, Construction technology trends, and construction stages, project management, 3d modeling.

1. INTRODUCTION

With remarkable advancements and modern technological advancements, the utilization of Unmanned Aerial Vehicles (UAVs) continues to revolutionize various industries and fields. By incorporating intelligent Drone-Powered solutions and employing scientific instruments, businesses have revolutionized traditional asset surveying and safety inspections. One vital sector that greatly benefits from the use of UAVs is construction site monitoring and planning, as it allows for improved performance, speed, and accuracy of information. This paper explores the diverse applications of drones, focusing on various construction project stages such as pre-planning, comprehensive surveying, 3D mapping, construction process monitoring, quality control, safety inspections, and marketing, among others.

In the realm of the ever-expanding construction site industry, planners and architects frequently utilize drones as a real-time tool to observe the progress of their projects and ensure alignment with their vision and imagination. The information gathered also motivates developers and construction businesses to keep track of their inventory. This blog eloquently elucidates how drones and Unmanned Aerial Vehicles (UAVs) have

revolutionized the construction industry through intelligent monitoring and reporting systems that rely on real-time data. UAVs, particularly in the construction sector, have propelled the field towards heightened efficiency and precision. In this research, we regularly employ UAVs or drones to map the job-site on a weekly basis. Routine surveying is essential for monitoring progress, conducting safety inspections, and ensuring real-time quality control. Drones provide a bird's-eye view of the entire project, uncovering concerns that would be otherwise impossible to detect through ground-level inspections. The geotagging capabilities of drone maps enable the capture of necessary area measurements, which can then be transformed into estimated stockpile volumes for prompt and reliable decision-making.



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

Additionally, beyond data collection, LiDAR drones serve as effective tools for monitoring and managing construction sites. Through the utilization of LiDAR drones to capture aerial footage of the site, project managers can closely monitor the progress and promptly identify any potential challenges. Moreover, these drones can create precise 3D models of the site, enabling project managers to gain a comprehensive understanding of the project and make well-informed decisions.

1.1 Aim

A thorough investigation was conducted to analyze the diverse ways in which drones are utilized in different sectors and phases of construction management

1.2 Objective

- 1) To find out it is imperative to gauge the effectiveness of drone technology when applied in construction management.
- 2) The utilization of drones in different stages of construction projects offers a promising avenue for exploration.
- 3) To assessing the influence of lidar drone technology on construction projects is of utmost importance.

1.3 Future Scope of study

- 1) Drones find regular usage in the construction field, encompassing all widely recognized applications of this innovative technology.
- 2) To fully embrace the user-friendly nature of this drone application.

3) Opportunity to learn about the ways in which project managers can enhance project ROI through the utilization of drone technology.

4) A comprehensive guide to utilizing drone in various stages of construction for optimal result.

1.4 Limitations of study

1. The presence of a skilled drone operator is of utmost importance for the efficient operation of a construction site.

2. The site's requirements are taken into careful consideration to ensure the availability of suitable drone options.

3. The weather conditions at the construction site may have an impact on the operational efficiency of drones

4. The responsibility for maintaining the drone has been duly assumed.

5. The generation of data from drone data necessitates the use of software.

2.0 EXPLORING THE APPLICATIONS OF DRONES AT EVERY STAGE OF A PROJECT

India's transition into its second phase of economic growth necessitates a focus on improving manufacturing and enhancing production resources. The construction industry plays a pivotal role in this process. The construction industry holds significant importance in India's overall output growth. Not only does it contribute substantially, but it also has strong linkages with other industries, resulting in a multiplier effect. Estimates suggest that the multiplier effect of construction ranges from 1.8 to 2, making it one of the highest multipliers in the economy. This is primarily due to the sector's labor-intensive nature, limited reliance on imports, and its extensive and diverse supply chain.

Therefore, it is crucial to prioritize increased productivity and competitiveness within the construction industry. Despite having a productivity level 58% higher than agriculture, the sector lags behind other industries and has experienced a decline in productivity in recent years. As a labor-intensive industry, the key to improving productivity lies in cost-cutting measures and streamlining processes. One essential measure for ensuring accident prevention is the regular inspection of construction sites. Traditionally, safety managers would physically conduct site inspections to identify potential hazards. However, the use of unmanned aerial vehicles (UAVs) and drones can offer a safer, faster, and more accurate alternative for inspections. These technological advancements can effectively identify new hazards and monitor the movement of equipment, people, and materials on construction sites. 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.

2.1 PRE-CONSTRUCTION PHASE

The preliminary phase of a construction project entails a series of crucial stages that must be completed before the physical construction can begin. Drones can play a significant role during this phase, facilitating tasks such as design, bidding, and site planning. During the design phase, the utilization of drones can offer designers a comprehensive understanding of the project's surroundings. Additionally, designers can take advantage of the precise 3D scans provided by drones, which can be seamlessly incorporated into modeling software. By considering the actual landscape, these scans enable designers to visualize the project within its environment and evaluate its practical and aesthetic implications for both stakeholders and the surroundings. During the bidding stage, contractors can benefit from drone images as they offer a comprehensive view of the site and its surroundings. This enables them to identify potential risks and hazards that need to be considered when preparing their bid. Additionally, drones can aid in the refinement and conversion of terrestrial surveying data, resulting in precise 3D maps that facilitate the estimation of quantities like earthwork volumes. By enhancing the accuracy of these measurements, the reliability of bids can be increased while minimizing estimation errors. When it comes to site planning, the exceptional accuracy of drone data facilitates the precise identification of site boundaries and the effective presentation of the construction plot area. This invaluable data empowers construction teams to meticulously plan various aspects of the site, including entrance and exit points, crane locations, and material storage areas. This becomes particularly significant in projects surrounded by restricted areas and no-go zones, such as existing utilities and environmentally protected lands.

2.2 CONSTRUCTION PHASE

The construction phase of a project encompasses all the physical activities that take place on the construction site. Drones have the ability to serve various purposes. Firstly, drones can be utilized for safety and health reasons. Safety managers can operate drones to gather real-time data on hazardous activities, blind spots caused by moving equipment, and violations of site parameters and restricted areas. Additionally, drones can be equipped with microphones to enable safety managers to communicate with workers who may be in danger and alert them about potential hazards. Notably, successful experiments have been conducted using drones to automatically identify and caution workers who are not wearing personal protective equipment, such as hardhats as well as identify openings and guardrails that do not comply with the standards set by the Occupational Safety and Health Administration. Drones have the capability to assist in resource and logistics management. They can offer immediate measurements of material quantities on site, including soil and aggregates. Additionally, drones can utilize real-time location systems to identify and track the movement of tagged materials and equipment using various sensing technologies. Furthermore, drones can act as valuable tools for unmanned equipment, like excavators with autonomous intelligent control units, enabling them to efficiently carry out earth moving operations. Tracking the progress of construction sites is another valuable application of drones. By maneuvering over the job site, drones can provide stakeholders with real-time updates on the ongoing developments, regardless of their physical location. This enables effective task

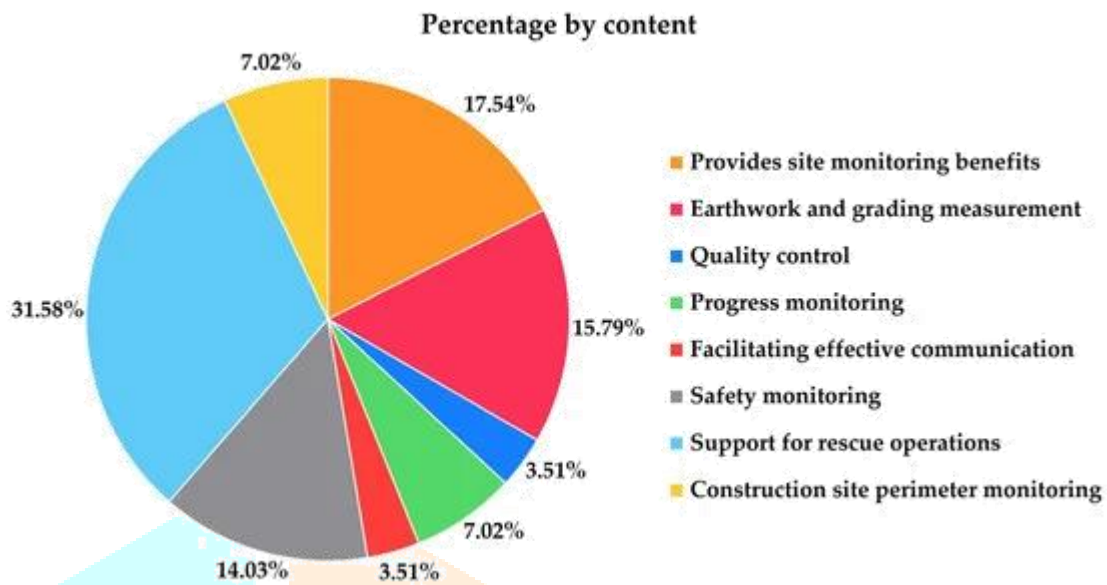
management, quality control, and a thorough comparison between the planned and actual progress. Furthermore, drones can even generate detailed 3D models of the completed structures, enhancing the overall monitoring process. Alongside 3D models and progress reports, the inclusion of drone footage provides a lasting documentation of the project that can be accessed whenever needed. To ensure a comprehensive understanding of the situation, stakeholders can make reference to the recorded drone footage. This footage not only serves as valuable evidence in resolving litigation, but also has the ability to clarify and explain oral testimony or documentary narrative in concrete terms. In addition to these benefits, drones have various other uses on construction projects. They can transport and install construction materials such as bricks, foam blocks, and steel elements. Drones can also be utilized for transporting labor tools, illuminating dark areas on the construction site, and providing lighting for night works. Furthermore, they can assist in finishing and painting walls and vertical slopes, monitoring dust and air quality, and detecting environmental violations. Drones are also effective in inspecting existing structures prior to repairs or remodeling, as well as managing demolitions or destruction of structures. This comprehensive record plays a crucial role in mitigating disputes, a common occurrence within the construction industry.

2.3 POST-CONSTRUCTION PHASE

The post-construction phase of a construction project encompasses all activities that occur after the physical construction is completed. During this phase, drones can serve various purposes such as mapping, marketing, monitoring, and inspecting. By utilizing drones, inaccessible and hazardous areas can be effectively mapped, particularly due to their ability to access difficult-to-reach locations and capture heights that are challenging for manual or laser scanning methods. This aerial perspective, when combined with advanced scanning technology, enables stakeholders to generate 3D models of existing structures, including historic landmarks. Additionally, drones offer a unique viewpoint that allows project owners and real estate agents to create captivating videos for marketing, sales, and promotions, particularly for commercial projects. Drones can play a crucial role in the surveillance and examination of various structures. For instance, they can be utilized to inspect and clean the exteriors of towering skyscrapers, identify corrosion on dam slopes, examine hazardous roofs like those constructed with slate or clay tiles and steep-slope roofs, and detect roof leaks or electrical hot spots on transformer installations that are not easily visible. These applications enable the detection of energy inefficiencies and the development of thermal maps. Additionally, numerous studies have explored the use of drones in managing highway infrastructure, including bridges and roads. Drones offer the advantage of maneuvering above, below, and around bridges without the need for heavy machinery or traffic control, thereby enhancing monitoring and inspection efforts. Similarly, drones can contribute to the periodic assessment of pavement conditions and distress monitoring on roads, reducing the required man-hours for

visual inspections and conducting in-situ tests to measure various factors such as distress, unevenness, rutting, and cracks. Furthermore, the integration of asphalt 3D printing technologies onto drones could

Figure 2. Percentage of content for drone applications at construction phase.



facilitate the filling of cracks in pavements. Drones are extensively utilized for post-disaster reconnaissance, serving as a crucial tool in assessing the aftermath of fires, explosions, and various natural calamities like earthquakes, floods, hurricanes, tornadoes, and landslides. By identifying a wide range of damage evidence, from minor cracks to total collapses, drones facilitate comprehensive damage assessment. Moreover, they play a vital role in expediting rescue operations, cleaning efforts, rehabilitation initiatives, and retrofitting endeavors. Additionally, the evidence collected by drones can prove invaluable when filing for post-disaster insurance compensations.

3. COST OVER THE LIFESPAN

The cost of implementing drones throughout their lifecycle can be divided into three distinct phases: procurement and acquisition, operations and management, and retirement and disposal. During the procurement and acquisition phase, it is necessary to obtain the required permits for purchasing and operating the drones, as well as consider the cost of the actual purchase. Various factors influence the purchase cost, such as the drone's weight (including battery, propellers, motors, controllers, frame, and take-off elements), payload capacity (including gimbals, cameras, and sensors), and endurance (including battery service). Additionally, expenses related to the necessary software for navigation, flightpath automation, control, monitoring, communication, and data gathering, storage, and sharing should be taken into account.

Moving on to the operation and management phase, costs are incurred for regular drone operation. These costs may include the lifespan of propellers and batteries, software adaptability, insurance, and the operating crew. Lastly, the retirement and disposal phase involve the recuperation of capital at the end of the drone's lifespan. Please note that these three phases encompass the comprehensive lifecycle cost of implementing drones.

4.CONCLUSIONS

The review of drone applications in the construction industry highlights the substantial contributions they make throughout different stages of the construction process, encompassing design, construction, and maintenance. The use of diverse drone types has demonstrated remarkable advantages in improving efficiency, precision, and safety within the industry. Drones equipped with advanced mapping capabilities and high-resolution cameras have brought about a significant transformation in site surveys and aerial mapping during the design phase. These drones have empowered construction professionals to gather precise data, create accurate 3D models, and evaluate topography, thereby facilitating well-informed decision-making and enhancing the overall design process. In the construction phase, drones have assumed a crucial role in monitoring construction progress, conducting inspections, and ensuring safety. With their real-time video transmission and thermal imaging cameras, drones offer a comprehensive and timely overview of the construction site, effectively identifying potential issues that can boost productivity. Additionally, drones have also proven their usefulness during the maintenance phase of construction projects. By conducting routine inspections of structures, buildings, and infrastructure, drones efficiently detect and identify any damages, enabling proactive maintenance, reducing costs, and extending the lifespan of assets. The utilization of drones in the construction sector has undeniably led to significant improvements in efficiency, precision, and safety throughout every stage of the construction process. With the continuous advancement of technology, it is anticipated that drones will progressively assume a pivotal position in shaping the forthcoming landscape of the construction industry. By harnessing the potential of drones, construction professionals will be empowered to enhance productivity, mitigate potential hazards, and successfully execute projects of exceptional caliber.

5.REFERENCES

- [1] Bou Hatoum, M., Piskernik, M., and Nassereddine, H. A comprehensive framework is proposed in their research paper for the effective implementation of big data in all stages of a construction project. This holistic approach aims to optimize the utilization of big data throughout the project lifecycle. The paper was presented at the 37th International Symposium on Automation and Robotics in Construction (ISARC) held in Kitakyushu, Japan in 2020.
- [2] El Jazzar, M., Urban, H., Schranz, C., and Nassereddine, H. In their study, the authors present a roadmap for Construction 4.0, which outlines the path towards shaping the future of the construction industry. The paper was presented at the same conference as the previous one, the 37th International Symposium on Automation and Robotics in Construction, also held in Kitakyushu, Japan in 2020.
- [3] Hatoum, M.B. and Nassereddine, H. The authors focus on the development of a framework specifically for the implementation of robotics in construction enterprises. Their research paper was presented at the EG-ICE 2020 Proceedings: Workshop on Intelligent Computing in Engineering, held in Germany in 2020.
- [4] Nassereddine, H., Schranz, C., Bou Hatoum, M., and Urban, H. This research paper presents a comprehensive map for integrating augmented reality during the construction phase. The authors emphasize the importance of incorporating augmented reality technologies to enhance construction processes. The paper was presented at the Creative Construction e-Conference 2020, which took place online.

- [5] Chinchane A., Singh S. P. and Sumant O. This market outlook report provides insights into the Construction Drone Market. It discusses the current trends, market size, and future prospects of the industry. The report was published by Allied Market Research and can be accessed online.
- [6]. The Federal Aviation Administration (FAA) provides information and guidelines regarding Unmanned Aircraft Systems (UAS). Their website offers resources and regulations related to the use of drones in various sectors, including construction.
- [7].Zhou, Z., Irizarry, J., and Lu, Y. A comprehensive framework for utilizing unmanned aerial systems in construction project management. *Journal Of Management In Engineering*, 34(3):04018004, 2018.

