Implementation of Unmanned Aerial Vehicles in Large Scale Projects by Incorporating Time Management

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Abstract—The integration of Unmanned Aerial Vehicles (UAVs) into project management processes presents a transformative approach to reducing project timelines. Unmanned Aerial Vehicles (UAVs) invoke drones is helpful in project management in managing the time which benefits the project manager and contractors with speediest technology with detection of early issues and accurate progress on any project sites. With an older techniques and time consuming and delay in projects leads to various issues like project timelines management, scheduling the upcoming activities and reducing cost and risks in projects. UAVs plays an important role in construction industry to overcome certain difficulties with a proper time management techniques now. Most of companies are introduced with drones in project to reduce communication and coordination problems in projects to overcome an overall project risk and maintain efficiency UAVs are new replacement in construction industry. UAVs equipped with advanced sensors also gives rapid and precise aerial views with enabling real- time monitoring and quick decision making. This also helps in reducing the time spend on Manual inspection and mitigates safety risks. Also enhances the communication with up to date.This paper aims to understand the implementation of UAVs in project management and to avoid traditional construction techniques and improve faster construction and Time management to improve project timeline and work with efficiency.Through a review of literature study and examples of case study and analysis this paper explores the potential of UAVs in enhancing the various aspects of project management. Addressing the initial challenges and issues with importance of implementation of UAVs and also this study also highlights the significant time savings achieved by implementation of UAV technology in project management and a process of transformative approach to reduce the project timelines.

Keywords— Time management, Faster Construction, Drones, Technology Transformation

INTRODUCTION (HEADING 1)

Drones (UAVs) are setting a new standard in construction project management. According to a recent industrial report India is one of the fastest-growing markets for UAVs. Is expected that by the end of the next decade i.e., 2030 drones in construction sector will record a manifold escalation and will play a principal role in innovative buildings. As the industry develops and construction project faces more complicated, the use of drones in construction will continue to escalate.

While drones in construction are not the new construction, companies are adopting them at a faster rate than even ever before drones are taking an essential place in construction process and are only growing in popularity and functionality. According to the recent 'Flying High' 2018 report by the ECI-PwC, the construction sector is expected to employ around 2.5 lakh drone operators to be implemented for various activities

The global construction industry has experienced 239% growth in drone use year over year, which is higher than any other commercial sector further, technology advancement is healthy science in emerging economies, which enabled them to enhance their growth. It is estimated that commercial drone market will grow at a **CAGR** (Compound Annual Growth Rate) of between 16% and 17% from 2017 to 2023.

The Need of UAVs in India latest by 8 years has an enormous growth in economy as well as It is essential to understand the technology carefully before implementing the UAVS project. A future-oriented view must be taken to ensure that issues such as technology upgrade and scalability are deliberated well in advance. Setting a new vision in construction Industry is need in rapid development. To ensure successful implementation of the project, it is essential that the selected the need of study Regarding Implementation of UAVs in India is in rise. utilization UAVs in India for construction and project management in large scale projects.

the recent technology advancement it is explored that use of UAVs (unmanned aerial vehicles) or drones is continuously increasing the intake in the field of construction and the rapid change in improving the technology in the real world to solve several stages and use of UAVs in different various sectors in construction as well as project management in large scale projects in India. Construction sector is one of the major employments generating sector in India that has seen a decline in its productivity over the past few years because of not adopting new technology like other disciplines. Since it is a labour-intensive industry, adopting drone

technology can increase its productivity by saving cost, time and resources According to the recent survey the use of drones implementation takes a construction and project management progress. The UAVs implemented in a project including Pre- planning, Detailed Survey, Mapping, Monitoring etc. According to new survey the advanced Technology of UAVs is implementing the core issues of Project managers and contractors in the large scale projects in India.
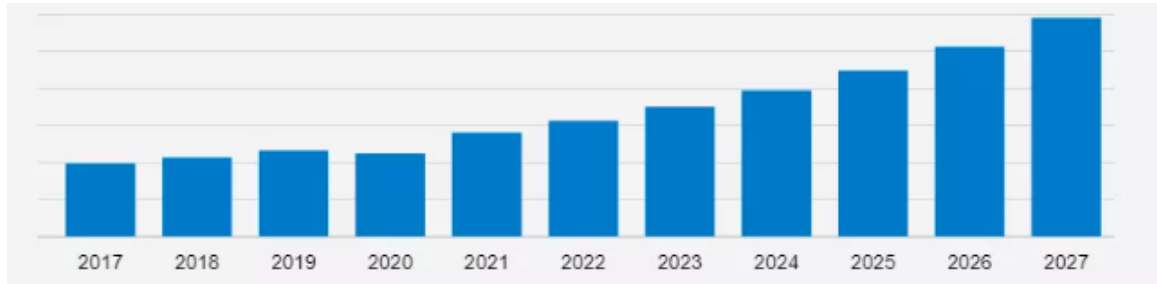

Figure 1.2.1 Graph of use of UAVs in India

Drone-monitored construction sites saw a 91% reduction in potentially dangerous mishaps. Since 2016, the drone manufacturer 3D Robotics has received repeated investments from Autodesk, a market leader in software for architecture and construction, through its Forge Funds. Forge Platform from Autodesk is being used by 3D Robotics to offer a UAV-to-cloud solution. Their drones may gather site information that is then analyzed using the Autodesk software. The drone serves as a little replacement cell tower that can be used to distribute the load on static towers at catastrophe scenes or during major events. Therefore, such factors are expected to drive demand for drones in industrial applications during the forecast period.
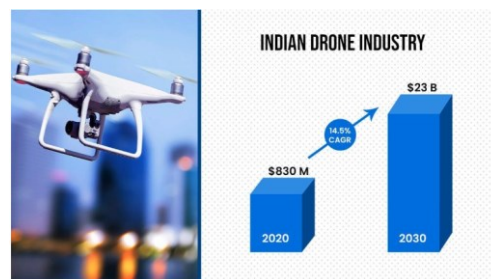
INDIAN DRONE MARKET:

Figure 2-1.2.2- Chart of CAGR Drone Industry

Recently, Government launched an event called "Drone Mahotsav" to promote the drone industry. During his speech, he highlighted the significance of drone technology in a variety of fields, including agriculture, tourism, disaster management, and the military. With the worldwide drone market poised for exponential growth in the foreseeable future, the Indian government anticipates significant milestones in the domestic drone industry. Projections suggest that within the next three years, the annual sales turnover of the Indian drone manufacturing sector is expected to surpass Rs 900 crores, while the drone services sector is forecasted to exceed Rs 30,000 crores. This surge in market development is not only anticipated to foster economic growth but is also projected to catalyse the creation of over 5 lakh jobs across various sectors within the drone industry.

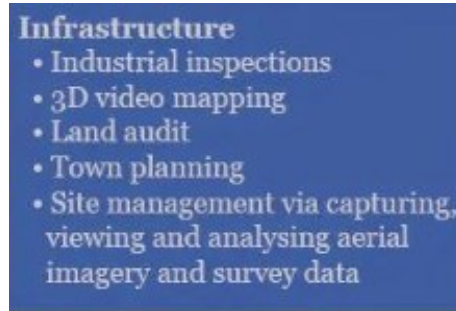Figure 3- 1.2.3 Drone use in C.I in India

Figure 4-1.2.4 Drone application use in C.I in India

India's journey towards establishing itself as a global drone hub by 2030 is marked by significant strides and promising initiatives. The introduction of Drone Rules 2021, the launch of the DigitalSky website, and the implementation of the Production-Linked Incentive (PLI) scheme underscore the government's commitment to fostering a conducive regulatory environment and incentivizing domestic manufacturing. Additionally, measures such as banning drone imports for commercial applications and abolishing drone pilot license requirements reflect a strategic focus on promoting indigenous capabilities and streamlining operational procedures.

Moreover, the identified areas for further improvement, including easing import processes, fostering ecosystem development, ensuring safety, simplifying insurance procedures, and enhancing skill development for drone pilots, present actionable opportunities for stakeholders to address existing challenges and propel the industry forward.

With concerted efforts from government agencies, industry players, academia, and other stakeholders, India is well-positioned to capitalize on its strengths, leverage emerging opportunities, and overcome hurdles on its path to drone industry dominance. By embracing innovation, collaboration, and sustainable practices, India can not only achieve its vision of becoming a global drone hub but also drive inclusive growth, job creation, and technological advancement in the years to come. The momentum gained thus far serves as a solid foundation for a future where Indian drones soar to new heights, contributing to the nation's economic prosperity and technological prowess on the global stage.

Figure 5-1.2.4 Use of the Drone

1.1 WHY DRONES ARE USED BY PROJECT MANAGERS

In the construction sector, project managers bear a lot of responsibility. That involves constant vigilance is monitoring the environment, making sure everything is on schedule and under budget, and guaranteeing worker safety.

Project managers always work on reduce their workload while still ensuring the project's necessary level of efficiency and safety should be taken into account. Drones used in construction are one such instrument. The use of drones in the construction business increased by 239% in 2017 and is expected to continue growing in the future.

Many flexible and forward-thinking project managers have started Drones in projects. Drones are becoming more and more common in the construction industry for a variety of reasons,

including their smooth and simple integration with enhanced project management procedures. Here are a few of the inventive uses of drones by project managers to improve their operational procedures.

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have become a critical tool in modern construction project management, offering unparalleled capabilities in site monitoring, data collection, and project visualization. However, their adoption is fraught with challenges that must be addressed to fully harness their potential. This literature review examines the limitations associated with the use of UAVs in construction project management, focusing on regulatory, technical, financial, and data management issues. Regulatory and legal challenges, including airspace restrictions and privacy concerns, pose significant barriers to UAV deployment. Technical limitations, such as limited battery life, payload capacity, and weather susceptibility, constrain their operational efficiency. Financial constraints, particularly the high initial investment and specialized training required for operators, can be prohibitive for smaller firms. Additionally, the vast amounts of data generated by UAVs necessitate advanced data analysis, processing, and secure storage solutions, presenting further challenges. This review synthesizes current research to provide a comprehensive understanding of these limitations and offers insights into potential solutions and future research directions to enhance the utility of UAVs in construction project management.
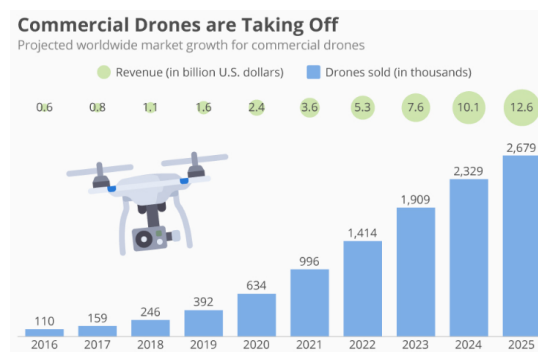

Figure 6-1.3.1 Drone % of increase in C.I

a) What types of drones are used in construction?

There are three main types of drones used in construction surveying: multirotor drones, fixed-wing drones, and fixed-wing/VTOL drones.
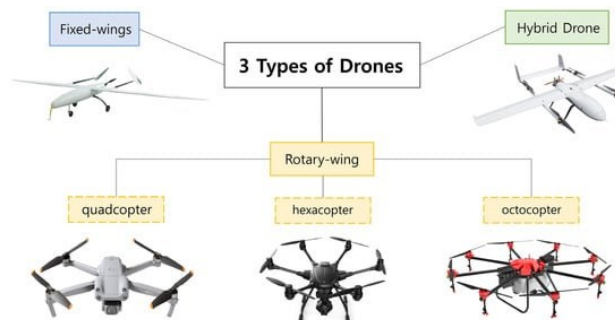

Figure 7-1.3.2.-Types of drones used in C.I

1.2 IMPLEMENTATION OF UAVS IN CONSTRUCTION AND PROJECT MANAGEMENT

APPLICATION OF UAVS IN CONSTRUCTION AND PROJECT MANAGEMENT

Unmanned Aerial Vehicles (UAVs), or drones, have become increasingly essential in the construction industry, transforming project management with their advanced capabilities. This literature review examines the various applications of UAVs in construction and project management, highlighting their significant contributions to efficiency, accuracy, and safety. Drones are extensively used for site monitoring and surveying, providing real-time data collection and detailed aerial imagery that enhance decision-making and project planning. They facilitate remote inspection of hazardous areas, improving safety by minimizing human exposure to dangerous conditions. Additionally, drones reduce costs and lab or associated with traditional surveying methods, offering substantial time savings. UAVs support progress tracking and quality control by capturing up-to-date visuals of construction sites, ensuring adherence to project timelines and standards. This review synthesizes current research to illustrate the multifaceted

applications of drone technology in construction and project management, while also addressing the challenges and limitations that must be overcome for broader adoption.

Why Aerial Maps and 3D Models are Transforming Project Management

Figure 8-1.4.1 Difference of Technique

JUSTIFICATION WHY IT IS NEED
Key Attractiveness of the Report

- COVID-19 Impact on the Market.
- 10 Years Market Numbers.
- Historical Data Starting from 2016 to 2020.
- Base Year: 2019
- Forecast Data until 2026.
- Key Performance Indicators Impacting the Market.
- Major Upcoming Developments and Projects.

Key Highlights of the Report

- India Commercial Drone Market Overview

- India Commercial Drone Market Outlook

- India Commercial Drone Market Forecast

- Historical Data of India Commercial Drone Market Revenues & Volume for the Period 2016-2019

- India Commercial Drone Market Size & India Commercial Drone Market Forecast of Revenues & Volume until 2026

- Historical Data of India Commercial Drone Market Revenues & Volume, By Types, for the Period 2016-2019

- Market Size & Forecast of India Commercial Drone Market Revenues & Volume, By Types, until 2026

- Historical Data of India Commercial Drone Market Revenues, By Applications, for the Period 2016-2019

- Market Size & Forecast of India Commercial Drone Market Revenues, By Applications, until 2026

- Historical Data of India Commercial Drone Market Revenues, By Regions, for the Period 2016-2019

- Market Size & Forecast of India Commercial Drone Market Revenues, By Regions, until 2026

- Market Drivers and Restraints

- Porter's Five Force

- India Commercial Drone Market Trends & Evolution

- Industry Life Cycle

- Market Opportunity Assessment

- India Commercial Drone Market Overview on Competitive Benchmarking

- India Commercial Drone Market Share, By Players

- Company Profiles

- Key Strategic Recommendation

In this section initial exploration of the study with news article and online research leads to further data collection and understandings with the topic and the issues related to implementation of unmanned aerial vehicles in construction and project management leads to the further study of time management, efficiency, safety and the other issues. Main problem identified is that the challenges to implement of UAVs in large scale construction. The study from the survey shows a drastic change in drone market and the study identifies the issue with saving time and project deadlines, schedule Delays and obtaining quality work in the projects. Thus this paper implement a solution which can be applicable in any similar situation and improvise the technology available in the construction process Also This Study presents a framework for the development of smart construction using UAVs and the key steps to decrease the traditional approach towards the construction based on Time-saving and apply the conventional way of approach towards the construction,

- Challenge 1: Adapting and Implementation the UAVs in Construction and project management Consultancies with focusing on time management.
- Challenge 2: Utilization of technology current Trends and to Improvisation of Project timelines and Schedule delays in Projects focusing in large scale projects in India. Etc
- Challenge 3: To achieve and face the challenge Regarding the project expectations and timelines must be pre-defined and clearly communicated to ensure that project objectives are met timely as per the identified use cases In this chapter it describes about the depth of the background and research area and problem with the Aim, objective, need of the thesis with organization.

1.3   WHY UAVS SHOULD BE UTILIZED IN PROJECT MANAGEMENT RELATED TO TIME MANAGEMENT

Project management Triangle is also known as IRON triangle.
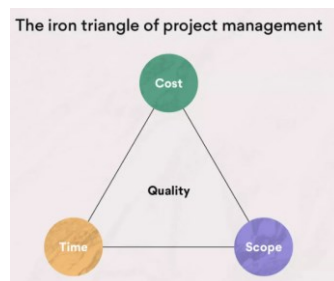

Figure 9-1.5-Iron Triangle

It is a Triple constraints of project management. When the 3 interdependent project constraints: project timeline, project budget, project scope is worked in a balance and it is achieved that project successful. When a project's timeframe and budget get the majority of the attention during project planning, project scope is just as important.[10]

However, the cost was not analyzed due to its broad scope of application. The further study focusses on Implementation of Time management with Respect to UAVs

Elements of time management might include:
- Overall project timeline
- Hours worked on project
- Internal calendars and goalposts
- Time allotted for planning and strategy
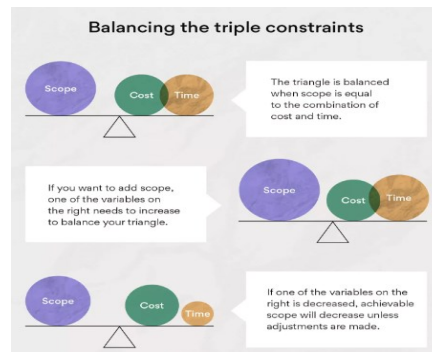
Number of project phases.[10]

Figure 10-1.5.2-constriants

if there is a malfunctioning in all or any one of these constraints, there is the possibility of an emergence of a risk that may affect the cost, time and quality of the project. So it is important to balance the Iron triangle finishing the project on time.

Finishing a project on time is one of the most crucial criteria for success in the mind of every project manager. Every single project has to do with factors like human resources (materials), economics (money), machinery (equipment), and methods (technicalities), which can be controlled. However, one factor that cannot be fully controlled is "time" which the project manager would have to always catch up with when conducting activities. [12]

Five Workflows for Project Management and Drones
So how, exactly, are project managers using drone data?
Five everyday workflows that can be streamlined and enhanced with aerial maps and 3D models.

Progress Tracking and Reporting
Weekly drone maps reduce the amount of time spent walking a site to monitor, track progress, and inspect for safety issues.
Create a comprehensive visual record of a project and easy comparison of progress over time. Leverage built-in annotation tools to generate reports for internal and external stakeholders.

Communication and Information Sharing
Drones simplify communication and information sharing, both internally and externally.
Keep everyone aligned and informed with up-to-date, easily digestible visual data.
Drone Deploy is cloud based, so it's easy to share annotated maps between team members in real time, or keep external stakeholders up-to-speed on the progress of a project through share links and interactive 3D models of a job site. Sharing an interactive 3D model allows customers, collaborators, and stakeholders to explore a job site remotely. This gives them a 360 perspective of the entire project.

Site Planning
For more informed planning, overlay drone maps with site plans such as utility, wastewater, and equipment clearances. Compare real-time site conditions against plans.
Catch conflicts early and redirect them at minimal cost.
For more advanced oversight and planning, export drone maps into industry software like BIM, GIS and CAD.

Subcontractor Management
Reference drone maps for real-time quality assurance, often before subcontractors even leave the site. Maintain accountability, preserve subcontractor relationships, and negotiate timely solutions that minimize project downtime.

Live Map: Real-time Drone Maps for the Job Site
Live Map turns hundreds of acres into consumable maps without the need to go back to the office. Get accurate aerial views of your job site faster than ever before.
Monitor the progress of your job site by keeping track of earthwork, equipment, subcontractors, and structures in real time.
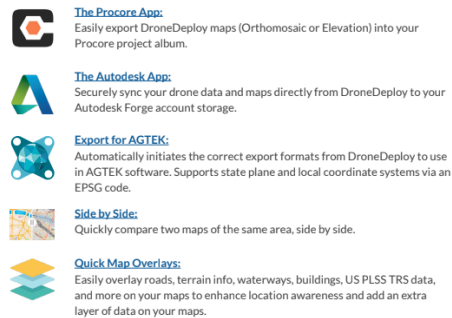
COMMON TOOLS AND INTEGRATIONS

Figure 11-1.5.3-Softwares used in PMC,CI

Four Basic Project Time Management Techniques:

- Define Activities: Identifying and listing all the tasks needed to complete the project.
- Sequence Activities: Determining the order in which tasks should be performed.
- Estimate Activity Durations: Predicting the time required to complete each task.
- Develop Schedule: Creating a timeline for project activities, incorporating estimated durations and dependencies.[9]

Project duration is one of the key factors that affect the success of any project. However, reducing the time required to complete a project can also pose some challenges, such as compromising the quality, scope, or cost of the project. How can you shorten project duration without sacrificing quality is a major question

1.4 AIM

The Aim of this dissertation is to identify and implement UAV technology with a focus on Time management with respect to enhancing efficiency, safety, and productivity, avoid schedule Delays, improve project timelines. This paper also explored the adaptation of technology in literature study as well as case studies which is helpful to adapt the technology available in the industry according to the recent survey of construction and to implementing most of the project management.

To develop a use of UAVs in construction and project management and to provide adaptation of UAVs for upcoming futuristic building construction.

1.5 OBJECTIVE

The research aims at studying the following:
The primary objective of using UAVs in time management is to accelerate data acquisition and analysis, leading to faster decision-making and overall project timeline reduction. And the data collection, analysis, and decision-making processes, UAVs significantly contribute to time management and overall project efficiency.

1) To create an advanced solution: To understand the current problems and present a solution for project deadlines, productivity improvisation and reducing the traditional method of construction and utilizing the technology.
2) To analyse existing UAVs in project : To review the existing literature Study and understand the Time management and speed construction using UAVs technology.
3) Implementation of UAVs and Benefits: Defined strategies that implement UAVs in project management for enhancing the defined project timelines and to reduce traditional methodologies.

1.6 RESEARCH QUESTION

1 How can Is UAV technology an efficient way to help time management?
2 How Is UAV technology in project Management effective for saving Time of construction?
3 How is technology used for project management as a solution for time management and Faster construction
4 Why Implication of UAV in large scale project -is really useful in reducing the time required for data collection and analysis.
5 Why Effective in finding loops in during building process is necessary.

6 Is UAV enabling project managers to track activities, identify delays, and optimize resource allocation to ensure projects stay on schedule.
7 why it really useful in improved project timelines, Minimizing schedule delays

7.1 RESEARCH OUTLINE

The research is carried out and presented into 7 different chapters. The dissertation report contains the following:

Chapter 1: Introduces the research, focusing on the need of enhancement of UAVs in project management in India by implementing and to reduce project timeline and working on the framework of reducing the time management in the projects and this chapter also include the research questions guiding the study and to provide a quick summary of implementation of technology in India for large-scale projects with proper execution and efficiency, safety with proper scheduling in projects. Also focus on reducing the traditional method of construction in building construction in India. The chapter outlines the study of aims to provide benefits of project life cycle and improve accuracy and communication and competence in construction project management.

Chapter 2: Research Methodology: The Research Methodology adopted to mixed method of research that is qualitative and quantitative research and also the chapter identified the process of literature review, case studies, personal interview and identify the solution and challenges faced in the project it also covers the effectiveness of current trends in CPM.

Chapter 3: Literature Review: The literature review on implementation of UAVs in project management and focusing on time management reviews the geez strategies used to minimise the traditional way of construction and also finding the way to minimise the time line in the project and avoid the schedule delays. Literature review also helping challenges faced in project management and to understand the current and future market trends which can be applicable in projects.

Chapter 4: Data Gathering: This paper explains the data gathering through different approaches survey questionnaires were formed and personal interviews were conducted in person. Different types of literature review and case studies were analysed to Generalize and data gathered through common factors. Literature review to understand the current and future market trends.

Chapter 5: Data Analysis: Unmanned Aerial Vehicles (UAVs), commonly known as drones, have become a critical tool in modern construction project management, offering unparalleled capabilities in site monitoring, data collection, and project visualization. However, their adoption is fraught with challenges that must be addressed to fully harness their potential. This literature review examines the limitations associated with the use of UAVs in construction project management, focusing on regulatory, technical, financial, and data management issues. Regulatory and legal challenges, including airspace restrictions and privacy concerns, pose significant barriers to UAV deployment. Technical limitations, such as limited battery life, payload capacity, and weather susceptibility, constrain their operational efficiency. Financial constraints, particularly the high initial investment and specialized training required for operators, can be prohibitive for smaller firms. Additionally, the vast amounts of data generated by UAVs necessitate advanced data analysis, processing, and secure storage solutions, presenting further challenges. This review synthesizes current research to provide a comprehensive understanding of these limitations and offers insights into potential solutions and future research directions to enhance the utility of UAVs in construction project management.

Chapter 6: Findings: the finding in this paper are collected through secondary data. The secondary data are collected directly from the professionals, contractors and experienced project managers in person. The key challenges were highlighted with the various factors and analysed through the data analysis. The solutions to the defined problem were discussed and highlighted broadly.

Chapter 7: Conclusions and Recommendations: In conclusion, it could be stated that it is important to adapt the drone technology in construction and project management projects to make the efficient, safety and time savings with managing project deadlines. Another important issue to be noticed that regulations on drones to be taken care and adopt the new technologies releasing according to the 2023 regulations to have a better procurement of drones and competitive in current market. Also, the study focusses on the implementation of UAVs to reduce traditional construction methodology and use of technology.

RESEARCH METHODOLOGY

The topic of research being broad and process formative in nature demands that the process of the dissertation include a gathering of quantitative data and Qualitative data. The sources for collecting this data are: Primary Data

Personal Interviews –

Different project managers were interviewed regarding the UAV technology in project management.

- Secondary Data
- Literature Study –
- Live information about UAV technology were studied and understood in Detail.
- Literature study of different projects used of UAVs regarding different problems were analysed and understood.
- This different project was collected from Research publications, websites, books and live projects and case studies.

II. CASE STUDY –

- Different case studies and projects were studied with the help of online and understood the

- Different aspects and situations use of uav technology to reduce time and data collection and analysis.

- Case studies helped in understanding the loops in building process and different challenges faced during usage of UAVs in projects.

- This case studies also helped in understanding the futuristic growth and faster construction and usage of UAVs in different aspects and parameters of project management.

- Questionnaire Survey: Includes the Sample survey of professionals from different fields of Construction Industry to understand the following:

o Role and Effectiveness of UAVs in Construction Industry
o Technology available in UAVs in building construction
o Implementation of UAVs in project management
o Future of are UAVs in Construction Industry etc.

2.1   RESEARCH SUBJECT

After the study and research on UAVs with different aspects with respect to project management consultancies and the study use of UAVs is blooming through recent survey it is understood that the implementation of UAVs in industry is very important and is suggested to be don't implement in the projects to perform a efficiency, safety and effectively time completion with the less use of traditional technology and construction methodology. However The technical errors and installation of UAVs is higher in cost in the initial stage. It performs the satisfactory execution with less labour, manpower and proper resources management.
The report shows the 50% work is faster and efficient by implementing it in reality when compared to the PMC suggest that it is in really necessary on sites for high-rise construction.

2.2   SCOPE OF STUDY

The scope of UAVs (Unmanned Aerial Vehicles) in construction is vast and continuously expanding as technology advances and their applications evolve. This thesis investigates the different and most current approaches used to solve and reduce Delays in overall project and improve timeline with unexcepted Delays in project. The scope of UAVs (Unmanned Aerial Vehicles) in construction is vast and continuously expanding as technology advances and their applications evolve. Despite their significant contributions to enhancing site monitoring, data collection, and project visualization, the adoption of UAVs in construction project management faces several limitations. This literature review delves into these constraints, highlighting regulatory and legal challenges, such as airspace restrictions and privacy concerns, that impede widespread UAV deployment. Technical issues, including limited battery life, payload capacity, and susceptibility to adverse weather

conditions, further restrict their operational efficiency. Additionally, the high initial investment and need for specialized operator training present barriers, particularly for smaller firms. Data management complexities, encompassing the processing and secure storage of vast amounts of data collected by UAVs, pose additional hurdles. By synthesizing existing research, this review provides a comprehensive understanding of these limitations and offers insights into potential solutions and future research directions to enhance UAV utility in construction project management.

2.3 LIMITATIONS OF STUDY

- The study excludes In the limitation of the study it excludes residential projects on the other hand it is included with large-scale residential projects example apartments, High rise buildings etc.
- The comparative study is limited to only literature study but also provide a broad understanding in relevant study and projects.
- It is limited to access areas and also critical for initial installation and adaption.
- The study of time management also broad understanding of other Similarities in same the study and also include 3 iron Triangle in PM.

2.4 LITERATURE REVIEW

After several comprehensive literature studies on the implementation of these project management techniques, it was observed to the best of research knowledge that very little research work has been done concerning the very practical application of these two techniques typically for the design and development of UAV projects [12].Different types of Literature projects were reviews with the help of Articles, journals and online study. The different challenges faced related to the UAVs and implementation was focus in the literature study and advancement in India for implementation of UAVs in construction industry was addressed. With the help of quantitative survey the different set of questions and common analysis were found and proposed a possible solution of adaption of UAVs in project management were discussed through the help of literature review Time management in project was focused in Depth for the experimental study.

2.5 DATA ANALYSIS

The analysis was done with the help of transformative Technology in construction Industry The data gathered from the PMC, CM and also the impact of implementation of drones in large scale industries to minimize the Time management was deeply analysed through successful project through the help of literature review. The use of transformative technology, such as UAVs (Unmanned Aerial Vehicles), in the construction industry has significantly enhanced the way data is gathered, analysed, and utilized. The integration of UAV technology in the construction industry provides transformative benefits for data collection and analysis. It enhances the accuracy, efficiency, and safety of the construction process, and supports PMCs and CMs in making well-informed decisions, managing risks, and achieving project milestones effectively.

LITERATURE REVIEW

3.1 Study on successful UAV implementation in a Major Construction Project

3.1.1   Bengaluru-Mysuru Expressway Project Brief

Location	National Highway Authority of India (NHAI) Bengaluru-Mysuru Expressway
Area	**Lanes**: 6 – 10(20,193 acres)
Technology Used	**Use of UAVs Technology**
Total Estimated Cost	Rs. 8,066 crore
Completion Deadline	October 2022
Project's Length	119 km
Status	Completed

Figure 12-3.1.1-Project Brief

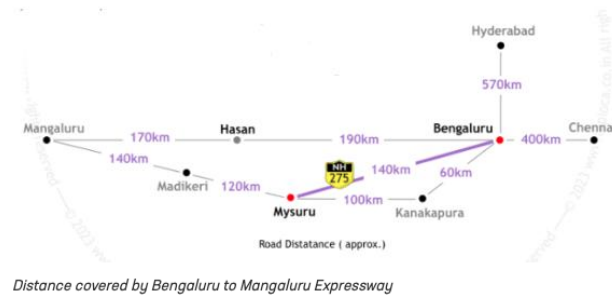Distance covered by Bengaluru to Mangaluru Expressway

Figure 13-3.1.2- Location

The focus of this literature study is the Bengaluru-Mysuru Expressway project, a landmark initiative utilizing UAV technology extensively for its development. This project was chosen due to its scale, complexity, and the strategic implementation of UAVs to overcome various challenges.

Bengaluru – Mysuru Expressway project on NH-275 is an operational 6 lane access-controlled highway with a route alignment in Karnataka.

This mix of brownfield-upgrade (60%) and greenfield (40%) project was envisioned under Bharatmala Pariyojana (BMP) as an alternate to the now-scrapped Nandi Infrastructure Corridor Enterprises (NICE) Road.

The expressway was inaugurated and opened by Prime Minister on March 12, 2023. The project had a prior deadline of October 2022.

Project consist the land of Greenfield sections will form bypasses around Bidadi (7 km), Ramanagara-Channapatna (22 km), Maddur (7 km including 3.5 km of elevated highway), Mandya (10 km) and Srirangapatna (7 km). Toll booths will be built at Kumbalgodu and Srirangapatna.

Figure 14-3.1.3- Site Photo

Figure 15-3.1.4- Site photo 2

3.2   CHALLENGES FACED IN THE PROJECT

The Bengaluru-Mysuru Expressway project faced multiple challenges, including:

Terrain and Accessibility: The project spanned across varied terrains, making traditional surveying methods time-consuming and less accurate.

Project Monitoring: Ensuring timely progress and quality control across the extensive project area was daunting.

Safety and Risk Management: Identifying and mitigating potential hazards in real-time was critical for the safety of the workforce and the project's success.[15]

TIMELINE OF THE PROJECT DEVELOPMENT

| March 2018	Foundation stone was laid
April 2018	Construction contract was awarded to Dilip Buildcon for Phase 1
March 2019	Construction work was stalled because of land acquisition problems
April 2019	Land acquisition began
May 2019	Work on Phase 1 began
December 2019	Work on Phase 2 started
2020	Work was delayed due to COVID-19
December 2021	Phase 1 completed up to 83% and Phase 2 up to 73%.
February 2023	Bangalore-Mysore Expressway reached final stage
March 2023	PM Modi inaugurated the expressway

Figure 16-3.2.1-Time line
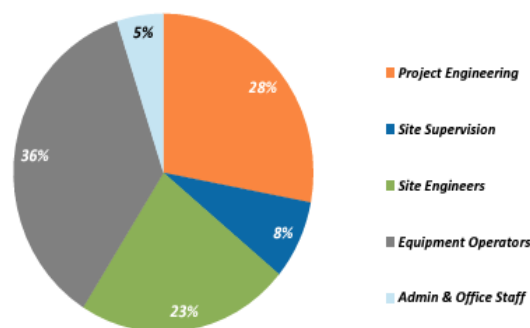
Figure 17-3.2.2 Pie chart of executive team

UAV IMPLEMENTATION AND SOLUTIONS

Aerial Surveying: UAVs equipped with high-resolution cameras and LiDAR technology were deployed for aerial surveying. This provided accurate topographical data, enabling precise planning and design adjustments in real-time.

Progress Monitoring: UAVs offered a bird's-eye view of the construction site, facilitating regular monitoring and reporting. This ensured that project milestones were met on schedule and any deviations were promptly addressed.

Safety Inspections: UAVs conducted routine safety inspections, identifying potential hazards and enabling pre-emptive measures. This significantly reduced the risk of accidents and ensured a safer working environment.[15]

OUTCOMES BY UAV IMPLEMENTATION

The UAV implementation in the Bengaluru-Mysuru Expressway project led to several positive outcomes:

Efficiency and Accuracy: The use of UAVs increased surveying efficiency and accuracy, reducing the time required for data collection and analysis.

Cost Reduction: UAV technology minimized the need for manual labor and traditional equipment, leading to significant cost savings.

Enhanced Safety: The proactive identification and mitigation of risks improved overall safety standards.

Data-Driven Decision Making: The wealth of data collected by UAVs facilitated informed decision-making, ensuring that the project adhered to the highest quality standards.[15]

CONCLUSION

The Main understanding of Project Management here is a broad view of gaining of large scale infrastructure into managing of process and procedures involved in project lifecycle. Drones are mainly used in significant consideration and contribution of proper project outcomes and used in various aspects such as site inspection, data collection, mapping, develop communication etc.

3.3 NAGPUR METRO RAIL PROJECTS

This Metro rail project stands apart as a different in Indian construction sector with the implementation of geospatial and BMI technology to enhance efficiency and productivity with the help of an unmanned aerial vehicles

Project will consist of 38.215 Km metro corridor, 38 stations and 2 Depots. The entire stretch will be divided into 2 alignments or corridors

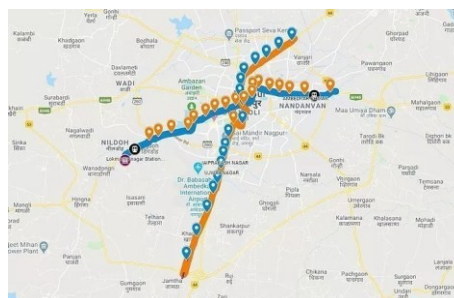| Alignment	Corridor	Rail Length	No of Stations
1	North – South Corridor	19.658 Km	18
2	East – West Corridor	18.557 Km	20

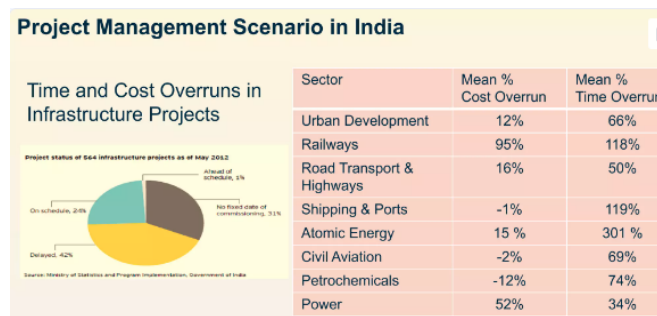Figure 18-3.3.1- Project Brief

Figure 19-3.3.2 Location
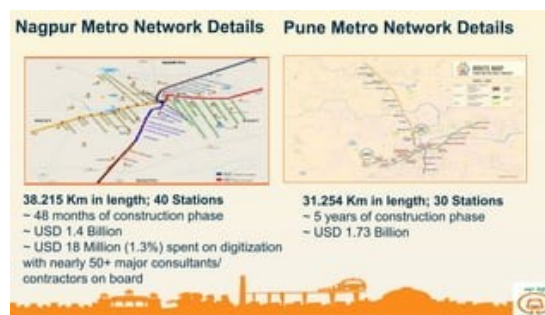
Figure 20-3.3.3 chart of PM

Figure 213.3.4 Location Network Details

3.3.1 THE CHALLENGE – COST OVERRUNS AND TIME DELAYS

The Nagpur Metro, like most Indian construction projects, was expected to face cost overruns, and delays, coupled with quality and safety concerns. Others such as land/site handover, coordination between stakeholders, weak documentation, connectivity of projectivity issues were discussed before the commencement of the plan/design and construction of the project. Additionally, it was foreseen, if the above-mentioned issues were not dealt with in the beginning, it would trickle down to the operations and maintenance phase of the project affecting efficiency and return on investments considerably.

To ensure that all interdependent disciplines and stakeholders collaborated and worked as a team, Nagpur Metro built a digital innovation solution for time and cost efficiency using geospatial and BIM solution. For the project, 22 design consultants and 15 contractors were deployed to ensure project stays on time and on budget.

CONCULSION AND OVERCOME OF CHALLENGES
USE OF 5D BIM SIMULATIONS AND PROJECT MANAGEMENT

In the initial phase of the project, drones was used to carry out survey along the alignment of the corridor. The data was used for geometric measurement in all directions and in spatial planning of the various stations and viaduct for checking probable clashes. Further the data was used to create the 3D models in the BIM model – in this case a 5D BIM model.

A 5D BIM model includes two additional dimensions on top of the 3D BIM model i.e. of time and cost. In the Nagpur project, after the collection of the drone data, the 5D BIM Digital Project Management Platform was created and implemented. The model was used for architectural modelling, structural modelling, MEP modelling, quantity estimation, 4D/5D simulation, and construction project tracking.

The digital platform also helped Nagpur Metro to achieve enhanced construction quality, develop comprehensive understanding of the project design, and optimize operational efficiencies.
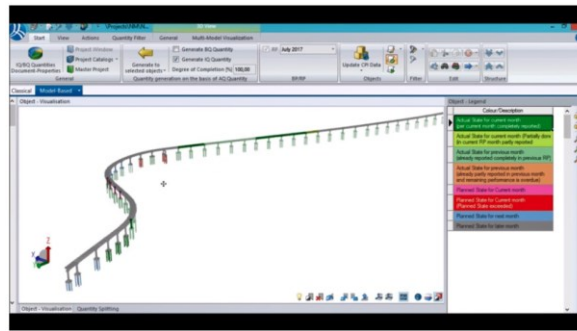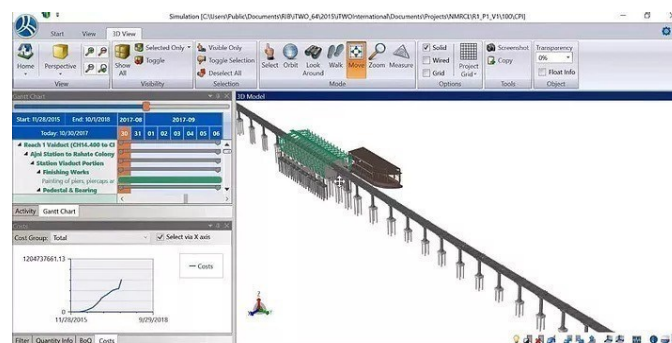
Figure 22-3.3.2.1- Model Reference

Figure 233.3.2.2-BIM reference

- MODEL BASED DELAY ANALYSIS

Because the data entered was analysed weekly and quarterly, NMRCL had model-based delay analysis. For example (see images below), the project's progress is shown in different colours: work completed in the previous reporting month, work in progress in the current reporting month, work planned for the next reporting month, and delayed work in the current reporting month. This ensures that management has a complete view at all times, allowing for more effective decision-making.

Figure 24 -3.3.2.3- Modelling

Nagpur metro is considered to be a benchmark for future mega infrastructure projects in India and the key success factors are:

- Collaborative & user-friendly working environment
- 3D model-based analysis from concept till commissioning
- Design-Drawing & Document Management System
- Effective project controlling & monitoring system
- Complete cost accounting system
- Asset information management system
- "Knowledgebase" for future metro projects in India

CONCULSION

Along with the other components of the digital project management platform has enabled us to undertake activities in a faster way, saving almost about 20% to 25% of the time, saving us cost, our project has been able to save almost about 10% of the cost so far. And we have been able to do all this, ensuring the high-quality standards and also high safety standards, in a manner that our complete lifecycle of the project becomes cost-efficient.Kohinoor coral project

Kohinoor Coral Hinjewadi will be constructed on 4 Acres of land parcel, 5 Towers with each tower of G+p+17

Floors, 2 BHK premium residences[17]

THE CHALLENGE –

Successful implementations This section will present real-world case studies in which the integration of drones and software has resulted in successful construction projects. By studying these examples, readers will obtain a practical grasp of the benefits and drawbacks of implementing these technologies. [17] Project: Kohinoor Coral - Successful drone installation in the project. The drone is used in conjunction with software that provides a specified path for the drone to acquire the required data, as well as its coordinates and other data stream that the software requires to process the same. The software processes visual input from drones and 360° cameras.

Regulatory and Legal Issues: The use of drones in construction is governed by regulations and laws. This part will go over compliance with aviation rules, privacy concerns, and how to navigate legal frameworks for drone use in construction. Despite the opportunities created by the widespread use of drones in civil engineering projects, there are still hurdles that must be overcome in order to fully realise the promise of drone technology in this industry.[17]

Technological issues: Integrating several software systems presents issues such as interoperability and cybersecurity risks. This section will look at the technological problems involved with the use of drones and software in building. One of the most important obstacles for the three phases of design, production, and maintenance is the limited flying time and range of drones, as battery life remains a substantial constraint. Most commercial drones have relatively short flight lengths, which limits their capacity to cover vast construction sites or assess significant infrastructure. This constraint reduces their overall operational efficiency, necessitating regular battery replacement and recharge. Currently, research and development activities in this industry are continuously improving battery energy density and recharging rates, allowing drones to operate for longer times and cover wider areas distances. The use of renewable alternative power sources, such as fuel cells, solar panels, or wireless charging, may also avoid the need for frequent battery changes while increasing operational efficiency. Environmental factors such as strong winds, rain, or fog might impair drone operations, causing project delays, which is another difficulty for drones. Drones are especially vulnerable to turbulence caused by high winds, and precipitation can damage sensitive electrical components, potentially resulting in downtime and increased maintenance.[17]

Figure 25-3.3.3.1-Master plan

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240

n be used to address the several challenges in the planning process of projects. Potential problems can be more readily detected by AR and VR compared to sketches and plans. [10]

Figure 26-3.3.3.2- Drone used in Site

DATA GATHERING

A Detailed Quantitative survey was conducted among the experts, professionals, experienced, consultancies etc. The challenges and problems were gathered from C.I and the questions were formulated according.

A set of People of PMC was surveyed with More than 15 project managers through calls and Linkedin and contractors and civil engineers and construction managers were questioned regarding the usage and implementation of UAVs. Discussion of suggestion were also focussed. Future in Drone markets, application etc Unmanned Aerial Vehicles (UAVs), or drones, have become crucial in construction project management, primarily due to their data-gathering capabilities. This literature review explores how UAVs contribute to time reduction in project management through efficient data collection and analysis. Drones facilitate rapid site surveys and inspections, providing real-time, high-resolution aerial imagery and 3D mapping. This immediate access to accurate site data enhances decision-making and project planning, significantly reducing the time required for traditional surveying methods. UAVs also enable continuous monitoring of construction progress, allowing for early detection of potential issues and timely interventions, thus preventing delays. Additionally, drones streamline communication and coordination among project stakeholders by providing up-to-date visual data, which helps in aligning project goals and timelines. This review synthesizes current research to demonstrate the role of UAVs in accelerating project timelines through improved data gathering and management, while also addressing the challenges and best practices for their effective implementation.

4.1 SURVEY QUESTIONS

The thought process for the questionnaire was formulated to understand the key challenges and utilization of UAVs challenges faced during in with project managers and construction managers PMC and CM company.

The series of seven questions asked were as follows:

- Majority of UAVs used in which type of projects?
- UAV- Is it really useful in Time Management - useful in improved project timelines, Minimizing schedule delays
- UAV technology minimize the Time -the need for manual labour and traditional equipment
- Implication of UAV in large scale project -is really useful in reducing the time required for data collection, analysis, efficiency, safety?
- UAV useful in terms of project milestones meeting on Does it shortens the time
- UAV enabling helpful in project managers to track activities, identify delays and optimize resource allocation to ensure projects stay on schedule
- Is it useful in Effective in finding loops in during building process
- How will the UAVs in reducing time management is Benefits for project Managers

CONCLUSION :

In the above highlighted Area which is implemented with UAVs for the time management and Faster and efficiency and Safety. Since the typical layout in construction and also to track the scheduling project timeline of each day is been observed and taken into consideration. Reducing Time of construction for Traditional techniques and Methodology. As a construction project manager, you are the hub of an ever-changing landscape.

But staying up to date on the many moving parts of a project sometimes feels like an

impossible task. Until now Most construction project managers choose to map their entire job site each week. This regular, overhead view is invaluable when it comes to tracking progress, inspecting forsafety issues, and keeping real-time tabs on every corner of a site. Because drone maps are geotagged, it's even possible to take basic area measurements and instantly estimate stockpile volumes for real-time decision making right on the spot. Annotate and share drone maps across teams for streamlined communication and reporting. Drone data can also be overlaid with additional site data, or imported into industry software for more advanced oversight and planning.[18]

FINDINGS

This chapter Explains about the findings of UAVs implementation and necessity in upcoming dates and increase an economy and innovative technology and transformation in construction industry.

KEY FINDING THEME 1

1. Major finding is to Improve the implementation in Project Management to Reduce Time of Traditional Techniques.

2. The biggest Problem in project management is to Reduce Unexcepted Changes in project Timeline and day to day scheduling.

3. By study of current Trends and increase in economy of UAVs in this upcoming Decades and implementation in project Management to proper efficiency in work, Reduce Time consuming, proper resource allocation etc.
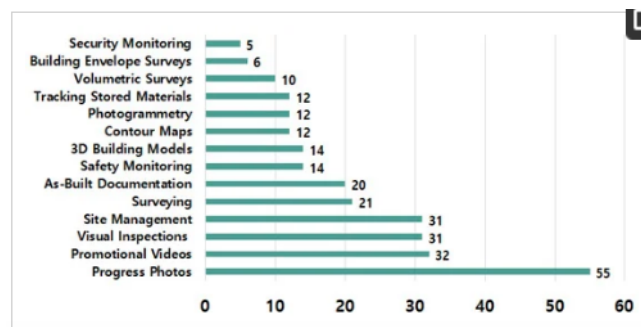

Figure 27-6.1.1- Use of UAVs in CPM

The Adapting the UAVs and drastic change in construction industry to implement the drones in construction and project management according to the survey given by global commercial drone market the increase in intake of UAVs is increased in 16 to 17% from 3% from the year of 2017 to 2023.[6]
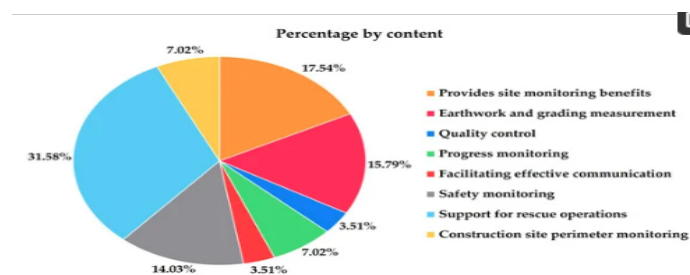

Figure 28-6.1.2 Pie chart

The Adapting the UAVs and drastic change in construction industry to implement the drones in construction and project management according to the survey given by global commercial drone market the increase in intake of UAVs is increased in 16 to 17% from 3% from the year of 2017 to 2023.[6]
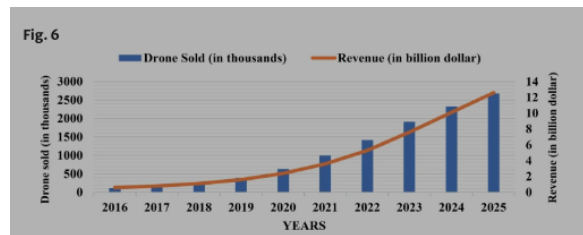
Figure 29-6.1.3-Graph of sale of UAVs

KEY FINDING THEME 2

Advantages and disadvantages of UAV IN CONSTRUCTION AND PROJECT MANAGEMENT The focus on Some of the Significant Advantages and Functions of Incorporating UAV or Drone Technology

- Benefits of Indian UAV/Drone Market
- Timeline of Drones and Exploration of Drone-Based Applications
- Construction is one of the most dynamic, responsive and unique sectors in the Indian economy.

KEY FINDING THEME 3

Application in India drone is not that much Benefited due to various features and aspects. The key finding also focus on not to be neglected on drone- based applications being explore in India.

Based on study of **The Construction Industry Development Council (CIDC)** a research finds that to evaluate the impact of drones on employment creation across 13 sub-sectors in the construction and maintenance industry. The study approximates the manpower requirement, that is, people with UAV or drone operating skills, to be approximately 2.5 lakhs in the coming years, with highways, roads, bridges and housing taking the lead. According to the CIDC, future operation of UAV technology and its better reception in several different applications across varied stakeholder base has the potential to enhance the demand for professionals who are competent to use this technology.

BROAD SOLUTION 1

Core Components of the Solution

1. Real-time Data Acquisition:
   o High-resolution imagery and video: Capture detailed visual information about the project site, progress, and surroundings.
   o LiDAR and sensor data: Collect precise measurements of topography, obstacles, and environmental conditions.
   o Data transmission: Real-time transfer of data to ground stations for immediate analysis and decision-making.
2. Progress Monitoring and Evaluation:
   o Time-lapse photography: Create visual records of project progression over time.
   o Volume calculations: Estimate material quantities and progress based on aerial imagery.
   o Deviation detection: Identify discrepancies between planned and actual progress, enabling corrective actions.
3. Resource Optimization:
   o Inventory management: Monitor stock levels of materials and equipment through aerial surveys.
   o Equipment tracking: Locate and track machinery and personnel on the project site.
   o Logistics planning: Optimize transportation routes and schedules based on real-time data.
4. Risk Assessment and Mitigation:
   o Hazard identification: Detect potential risks like erosion, flooding, or structural issues.
   o Safety monitoring: Monitor worker safety and equipment conditions.
   o Emergency response: Rapidly assess damage and coordinate relief efforts in case of unforeseen events.
5. Data Analytics and Visualization:
   o Data processing: Convert raw UAV data into actionable information.
   o Visualization tools: Create interactive maps, charts, and models for easy interpretation.
   o Predictive analytics: Use historical data to forecast project outcomes and identify potential bottlenecks.
   o BROAD SOLUTION 2
   • Time Reduction:
   o Faster data collection and analysis.
   o Improved decision-making and problem-solving.
   o Reduced manual effort and paperwork.
   • Cost Reduction:
   o Lower labor costs and inspections.
   o Optimized resource allocation.
   o Reduced project delays and rework.

   • Improved Accuracy:
   o Precise data collection and analysis.
   o Enhanced project planning and execution.
   o Minimized errors and rework.

   • Enhanced Safety:
   o Reduced risk to personnel in hazardous environments.
   o Early detection of potential safety hazards.

6.1.1 BROAD SOLUTION 3

The focus and reasoning for the broad solution

☐ **Accelerated project timelines:** Faster data collection, analysis, and decision-making.
☐ **Improved efficiency:** Optimized resource utilization and reduced rework.
☐ **Enhanced project visibility:** Real-time monitoring and progress tracking.
☐ **Risk mitigation:** Early identification and response to potential issues.
☐ **Cost savings:** Reduced labour costs and material wastage.

Unmanned Aerial Vehicles (UAVs) covers a transformative approach to project management by providing real-time data, enhancing efficiency, and optimizing resource allocation. This solution focuses on how UAVs can be integrated to reduce timelines and improve time management in projects.

CONCLUSION

After understanding and studying a conclusion will summarize key findings from the research and provide insights into the future role of drones in construction. UAVs enhancing Safety, efficiency and accuracy. This dissertation also has comprehensively analysed the latest Developments in UAVs technological advancements in project management. By implementing UAVs in construction inspections is not only challenges and limitations but also helps in Data processing challenges, safety and to reduce the traditional methodology and techniques and to avoid human errors as much as possible. This analysis helps in maximize the benefits and opportunities to use of technology. Use of UAVs in large construction that can benefit the project managers and also to reduce the time management and cost management.

Different types of projects with different scale will be having a different issue with Reducing the time and schedule timeline. Project managers will be always facing a challenge and find possibilities to improve the time and quality of work. The above shown studies and technologies save the projects from unexcepted issues and planned with upcoming schedules also. UAVs is really a larger scope in concern with recently available data and being explored and has been not implemented completely in the project management and construction. It ensures in the initial cost and challenges are complicated but also survey indicates that this technology very reliable in overall project especially for Higher scale construction.

RECOMMENDATION

Firstly recommendation of UAVS into project management offered sustainable time management benefits and adapting the faster data collection and real-time monitoring by following the research done above and by reviewing the study and report the recommendation is project managers can I have a control over the technology of using UAVs, for more efficient project execution and following the deadline of project completion and maintaining the scheduling of day to day and having proper timeline in the project. Important Success Elements (CSFs) According to this study, is those limited key areas which, if defined and measured carefully, can guide to achieve better results and successfully adopt and implement the UAV technology in its current and future projects" are the critical success factors, or "CSFs." Thus, "success" primarily relates to the organization's capacity to use UAV technology to its fullest potential and accomplish its intended results (i.e., cost savings, increased quality, improved safety, etc.) in relation to the process of implementing UAV technology in its building projects. UAVs implementation strategies can be helpful in specific project to avoid unexpected problems in the site and defects in the construction UAVs ensure that the traditional method of construction can be minimised and obtain a better timely completion.

FUTURE RESEARCH SCOPE

The report focusses on only on analysis of the UAVs in reducing Time management and the future research helps be in Detail about the implementation of UAVs in cost management and tests in similar cases of projects in India. Also, the technical aspects of drones should also be discussed in future studies as stakeholders' decisions on the usage of drones might be affected by these aspects. And focus on several emerging areas to further enhance their utility, efficiency, and integration. It will also identify potential areas for further research and development to maximize the benefits of drone technology in the CI & PMC.

• REFERENCES

An Overview of Drone Applications in the Construction Industry by Hee-Wook Choi,Hyung-Jin Kim,Sung-Keun Kim Wongi S. Na, Drones 2023, *7*(8), 515; https://doi.org/10.3390/drones7080515

[2] Info.Cecr.In/Drones-In-Indian-Construction-Industry/, Drones In Indian Construction Industry

[3] Recent advances in unmanned aerial Vehicles: A review,faiyaz Ahmed,J.c. Mohanta,Anupam keshari& Pankaj singh Yadav,volume 47.

[4] A Literature Survey of Unmanned Aerial Vehicle Usage for Civil Applications, Mithra Sivakumar1,* , Naga Malleswari TYJ1 1.SRM Institute of Science and Technology – Department of Networking and Communications – Chennai/Tamilnadu – India. *Correspondence author: nagamalt@srmist.edu.in https://doi.org/10.1590/jatm.v13.1233

[5] "Construction Monitoring and Reporting using Drones and Unmanned Aerial Vehicles (UAVs)
The Tenth International Conference on Construction in the 21st Century (CITC-10) July 2nd-4th, 2018

[6] CA case study on statue of unity: Engineering practices and challenges, Article DOI: https://doi.org/10.30574/gjeta.2023.14.2.0024, Kanniyappan S P *, Navikaran K, Mohana Krishnan G, Lakshmi Venkateswara Reddy Ch and Hari Haran K Department of Civil Engineering, R.M.K. Engineering College, Kavaraipettai - 601206, Tamil Nadu, India. Global Journal of Engineering and Technology Advances, 2023, 14(02), 043–046

[7] https://www.geospatialworld.net/prime/case-study/aec/nagpur-metro-rail-projects-use-of-drone-and-5d-bim-helps-with-efficient-project-delivery-2/ [8] "Tech 101: Construction drones | Construction Dive." [Online]. Available: https://www.constructiondive.com/news/tech-101-construction-drones/569796/. [Accessed: 15-Jun-2020].

[8] What is Time Management in Project Management? (n.d.). https://www.wrike.com/project-management-guide/faq/what-is-time-management-in-project-management/

[9] GeeksforGeeks. (2024, March 19). What is Time Management in Project Management? GeeksforGeeks. https://www.geeksforgeeks.org/what-is-time-management-in-project-management/#six-main-processes-in-project-time-management

[10] Asana, T. (2024, February 15). Project Management Triangle: What It Is, How to Use It [2024] • Asana. Asana. https://asana.com/resources/project-management-triangle

[11] Bhoda, S. K. (2024, February 4). Case Study: Successful UAV Implementation in a Major Construction Project. https://www.linkedin.com/pulse/case-study-successful-uav-implementation-major-project-bhodakzj7c#:~:text=The%20UAV%20implementation%20in%20the,for%20data%20collection%20and%20analysis.

[12] Amoah, R. (2022). Application of Project Time Management and Resource Management to a Novel Blended Wing Unmanned Aerial Vehicle (BWB UAV) Design. OALib, 09(09), 1–23. https://doi.org/10.4236/oalib.1109163

[13] Beena, A. A. (2024, April 8). The Transformative Impact of Drones in Construction Projects. https://www.bricknbolt.com/blogs-and-articles/home-improvement/transformative-impact-of-drones-in-construction#1-time-and-cost-savings

[14] Ai-Hajj, M., Ozcan-Deniz, G., & Ozorhon, B. (2022). Critical success factors for implementation of Unmanned Aerial Vehicles (UAVs) in construction. Journal of Construction Engineering Management & Innovation, 5(4), 228–252. https://doi.org/10.31462/jcemi.2022.04228252

[15] Nagpur Metro Rail | RIB Software Case Study. (n.d.). RIB Software. https://www.rib-software.com/en/case-studies/nagpur-metro-rail

[16] Helpline, D. (2024, March 26). India's Flight to become a Drone Hub by 2030: Opportunities, Challenges and Way Forward-. https://www.linkedin.com/pulse/indias-flight-become-drone-hub-2030-opportunities-challenges-ozr2c

[17] . chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.irjet.net/archives/V11/i6/IRJET-V11I602.pdf

[18] .drones_in_construction_management_fv3.pdf. (n.d.). Google Docs. https://drive.google.com/file/d/1twH10lKbqWlT_b9Yo-RvJ6tEjJ2N1qGu/view