

UAV's Applications in The UK Housing Sector: The Case of Site Management, Progress Monitoring, and Improving Health and Safety

Research Article

Volume 5 Issue 4- 2024

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Article History

Received: November 20, 2024 Accepted: December 04, 2024 Published: December 09, 2024

Abstract

Unmanned aerial vehicles, or UAVs, are a cutting-edge technology that could completely transform several industries, including construction. The purpose of this paper is to examine the various functions and applications of unmanned aerial vehicles (UAVs) to improve productivity, safety, and efficiency in the UK's housing and construction sectors. This study explores the current state of unmanned aerial vehicle (UAV) adoption in the construction industry, examining its various uses, including site management, progress monitoring, health and safety and site surveying. The benefits of UAVs are examined, such as their cost-effectiveness, time-efficiency, and data accuracy. Regulatory frameworks and integration challenges are also covered.

In addition, this research examines case studies and real-world UAV technology applications in the UK housing and construction industries, emphasising effective initiatives, best practices, and challenges faced. This research will assess the effect of UAV integration on project timelines, cost savings, safety enhancement, and overall project outcomes through qualitative and quantitative analysis. The skill sets, training needs, and workforce implications connected to the widespread use of UAVs in construction are also considered. The study also investigates the views, preparations, and perceptions of stakeholders regarding the use of UAVs in the UK construction industry.

Ultimately, this research seeks to shed light on the potential and constraints of unmanned aerial vehicles (UAVs) in revolutionising the UK housing and construction sectors, while also making suggestions for maximising their use and resolving integration-related issues. The chosen methodology seeks to provide a thorough understanding of how Unmanned Aerial Vehicles (UAVs) are integrated into the housing and construction industries. We'll use a mixed-approaches strategy that combines qualitative interviews with quantitative surveys. While qualitative data from interviews will offer deeper insights into the experiences and perspectives of stakeholders, quantitative data will be gathered through surveys to analyse trends and patterns. For quantitative data, statistical analysis will be employed, and for qualitative data, thematic analysis. Using stratified random sampling, the study will concentrate on professionals in the UK's housing and construction industries, ensuring representation from various market segments.

Introduction

This Research undertakes a thorough investigation of the application of Unmanned Aerial Vehicles (UAVs) in the construction and housing sectors of the United Kingdom. will," explains the complex environment surrounding UAV applications in housing and construction by carefully examining previous academic works, studies, and industry reports. Our investigation is organised around four main goals, each of which is carefully crafted to reveal the opportunities and challenges associated with incorporating drones into these

industries. The primary goal of this review is to decipher the nuances involved in using UAVs in the housing and construction industries. Through the integration of knowledge from prior academic research and industry evaluations, we aim to clarify the complex network of variables affecting the uptake, application, and consequences of drone technology in these fields.

Essentially, this review of the literature provides a solid framework for further analysis and discussion by providing a thorough synthesis of the body of knowledge. Through navigating the complexities of UAV applications in housing and construction, we hope to contribute



to a more nuanced understanding of the transformative potential of drone technology in influencing these industries' futures in the United Kingdom.

Drones In the Construction Industry

Unmanned Aerial Vehicles (UAVs), also referred to as drones, have attracted an abundance of attention of late because they have the potential to completely transform a number of aspects of the construction industry. The purpose of this section of the literature review is to offer a thorough analysis of the advantages and disadvantages of using drones in construction operations. According to Champ,H [1], one of the main drone advantages in the construction industry is the enhanced efficiency and productivity produced when a drone is used. scholar states the notable boost in production and efficiency that comes with using drones in construction is one of the main benefits. Fast aerial mapping and surveying are made possible by UAVs with sophisticated sensors and high-resolution cameras, which enable construction teams to collect precise and comprehensive topographic data more quickly than they could with more antiquated techniques. Reduced project timelines and cost savings are the results of this increased efficiency.

Furthermore, Peet, S [2], believes a vast advantage of implementing an increase of usage of drones in the construction industry in the UK can increase in the safety of onsite work. Drones can reduce the need for workers to perform dangerous tasks at heights or in hazardous environments, which could improve safety on construction sites. They can be used for surveillance, monitoring, and site inspections, which lowers the possibility of mishaps and injuries. Drones with thermal imaging cameras can also detect possible safety risks like overheating machinery or structural flaws, enabling early intervention. Due to roof access via scissor lift and large machinery can be deemed expensive, another vast advantage of drones in the construction industry is its cost saving efficiency. Drones save a lot of money during the construction lifecycle by automating repetitive tasks and optimising resource allocation. Their capacity to produce precise volumetric measurements and aerial surveys removes the need for expensive outside surveying services, leading to more effective project budget management. This was also backed by Harding, G. [3].

In Summary, majority of the analysis provided presents a number of promising answers to issues facing the construction industry, a thorough assessment of their benefits and drawbacks is necessary before incorporating them into workflows. To fully realise the potential advantages of drone technology in construction projects, it will be essential to tackle technological limitations, regulatory obstacles, and data security issues.

The UK's Housing Sector

The housing industry in the United Kingdom is at a turning point in its development, as it attempts to align with the Sustainable Development Goals (SDGs) that the United Nations has set forth for 2030. This review of the literature aims to clarify the complex problems that impede development in the UK housing industry and to look at the obstacles that stand in the way of achieving these global sustainability

goals. According to Perry,B [4], The ongoing affordability crisis is one of the biggest issues facing the UK housing market. For many people and families across the nation, housing is becoming increasingly unaffordable due to rising real estate costs, stagnating incomes, and a shortage of available housing. This crisis threatens social cohesiveness and economic stability in addition to increasing rates of homelessness.

Housing inequality and accessibility is another large problem stopping us from achieving the 2030 UN SDG Goals. Consistent with Appolloni,A [5] work, Socioeconomic inequality is exacerbated by persistent disparities in the accessibility and quality of housing in the United Kingdom. Vulnerable groups encounter disproportionate obstacles in their quest for safe and affordable housing, such as low-income households, members of ethnic minorities, and people with disabilities. Housing inequality is exacerbated by discriminatory practices in housing allocation and insufficient social housing provision, which prolongs cycles of poverty and marginalisation.

The Impact of Using Drones

Drones, also known as unmanned aerial vehicles, or UAVs, are becoming indispensable instruments in the housing and construction sectors. They provide a host of advantages, including improved health and safety procedures, progress tracking, and site management. This review of the literature intends to investigate and shed light on the various implications of incorporating drones into housing development projects and construction procedures, with an emphasis on site administration, progress tracking, and the improvement of health and safety.

The Barriers Laid Behind Implementing Drones

Due to their potential to completely transform a number of aspects of the construction process, drones, also known as unmanned aerial vehicles, or UAVs, have garnered a lot of attention in the construction industry in recent years. Drones can be used for mapping, surveying, tracking the status of projects, and improving safety, among other tasks. But despite their apparent advantages, there are a number of obstacles preventing drones from being widely used in the construction industry. In order to shed light on the difficulties preventing the smooth integration of drones into construction practices, this literature review attempts to identify and describe these barriers.

According to Onososen,A [6] Drone integration into construction processes is impeded by technological limitations. These limitations include limited battery life and endurance, restricted operational range and connectivity, and environmental sensitivity to wind and temperature. The capacity of drones to carry equipment necessary for construction applications is further limited by their payload, and there are compatibility and interoperability issues when integrating drone data with current construction software and workflows. To overcome these constraints, battery technology must progress to increase flight duration and energy density, and advanced communication technologies must boost operational range. Furthermore, creating drones that are more robust and resilient to the environment would allow them to be used in a variety of weather scenarios. Drones have the potential to improve efficiency and safety in construction projects, but only if these technological barriers are addressed and data integration processes are streamlined, and stakeholder collaboration is encouraged.

Another substantial barrier laid behind implementing drones in



the construction process, is Regulatory Compliance and Legal Issues. In accordance with Howe S, [7] There are significant obstacles standing in the way of the widespread use of drones in construction, including legal and regulatory compliance. Drone operations are subject to strict guidelines from federal aviation regulations, such as those set by the FAA. These regulations include restrictions on airspace, registration requirements, and pilot certification requirements. To guarantee compliance and reduce legal risks, negotiating these regulations necessitates strict adherence. Local ordinances and privacy concerns add to the complexity, especially when it comes to data collection and surveillance. Drone flight authorizations and permits can be expensive and time-consuming to obtain, which could interfere with project timelines and raise operating costs. Liability issues resulting from mishaps or property loss highlight the significance of having extensive insurance coverage and employing risk management techniques. While advocating for streamlined regulatory procedures and industry standards can facilitate the seamless integration of drones into construction workflows, improving operational efficiency and innovation, working with legal experts and regulatory authorities is crucial for navigating these complexities and ensuring compliance.

Best Drone Usage and Practise

According to Milnes,D [8], Drones provide unmatched capabilities for producing detailed maps of housing development areas and conducting site surveys. Research has demonstrated that drone-based surveys are more accurate and efficient than more conventional techniques like ground surveys or manned aircraft. Using high-resolution cameras and LiDAR sensors to obtain precise imagery and elevation data, planning flight paths for optimal coverage, and utilising photogrammetry software for accurate mapping and three-dimensional modelling are some of the best practices for using drones for site surveying. Improved site planning, design, and decision-making are also made possible by the integration of drone-generated maps with Geographic Information Systems (GIS) and Building Information Modelling (BIM) platforms throughout the housing development lifecycle.

Research Methodology

In order to explore the uses of Unmanned Aerial Vehicles (UAVs) in the UK housing sector, this study uses a mixed-methods approach, combining qualitative and quantitative research methods. It focuses on site management, progress monitoring, and health and safety improvements. While the quantitative component entails distributing a structured questionnaire, the qualitative component involves conducting semi-structured interviews. Professionals and stakeholders in the UK construction industry, such as project managers, site engineers, safety officers, and regulatory bodies, make up the sample population for this study. The study will utilise a purposive sampling technique to guarantee representation from diverse sectors of the construction industry.

Qualitative Methodology

Within the framework of this investigation, qualitative methodology presents a useful method for data collection and analysis. Focus groups, interviews, and observation are examples of qualitative methods that offer a means of gathering complex insights from housing industry stakeholders. Brannan,G [9]. The depth of understanding that qualitative methods provide is one benefit of using them in this study. Through in-depth analysis of intricate problems related to progress tracking, site management, and health and safety issues, researchers can

identify contextual factors, underlying motivations, and meanings that may not be visible when using only quantitative methods.

This level of comprehension is essential for handling the complex issues the housing industry faces. Moreover, qualitative research places emphasis on the perspectives and experiences of participants, offering a participant viewpoint that is crucial for comprehending the complexities of site management and safety issues in the UK housing industry. Qualitative research, by emphasising the viewpoints of those directly involved, allows for a deeper understanding of their experiences and difficulties, which can guide the development of more practical solutions for Improvement Pathak, V [10].

Quantitative Methods

Quantitative methodology is important in this study's context because it supports the study's goals. Quantitative methods involve the methodical gathering and examination of numerical data in order to assess theories, recognise patterns, and measure correlations between variables in the housing industry Sheard, J. [11].

The objectivity of using quantitative methodology in this study is one of its benefits. Quantitative research seeks to reduce researcher bias by using standardised data collection methods and statistical analyses, which improves the validity and trustworthiness of the results. This objectivity is especially important when evaluating elements connected to progress tracking, site management, and health and safety procedures, as unbiased evaluation is essential to making wise decisions. Additionally, because quantitative approaches provide statistical precision, researchers can recognise and validate important relationships and patterns in the data. Quantitative analyses enable the identification of statistically significant trends by precisely measuring and quantifying variables. These trends can then be used to inform strategies aimed at improving site management efficiency and guaranteeing health and safety compliance in the UK housing sector. Sreekumar,D [12].

Mixed Research Methodology

Within a single study, mixed methodology combines qualitative and quantitative approaches with the goal of enhancing each other's advantages and minimising their respective drawbacks. By using this method, researchers can triangulate their findings and gain a deeper comprehension of their research questions. Schoonenboom, J [13]. One advantage to this method is triangulation. Researchers can improve the validity and reliability of research outcomes by cross-validating findings using multiple data sources and methods. Another advantage of this method is enhanced validity. Research using mixed methods can overcome the shortcomings of single approaches, enhancing the validity and reliability of study results. Shorten,A [14].

One disadvantage to this research method is increased complexity. It can be difficult and time-consuming to carefully plan and integrate qualitative and quantitative components for mixed methods research. Another disadvantage of this research method is integration challenges. It takes methodological expertise to successfully integrate qualitative and quantitative data and analyses, and there may be difficulties in reconciling conflicting findings or interpretations. Jose, F [15]. The reason for picking this research method is due to the complexity of this research questions. This research aims to investigate various facets of unmanned aerial vehicle (UAV) applications in the construction sector, such as progress tracking, site management, and health and safety. In order to address these various aspects, a mixed methodology integrates



both qualitative and quantitative data to enable a thorough investigation. Dawadi,S [16].

Reliability & Validity

Certain measures will be taken to guarantee the validity of the information gathered via the questionnaire.

Pilot testing will be one of the strategies. A pilot test involving a small sample of participants who represent the target population will be carried out prior to the questionnaire being administered on a large scale. The purpose of this pilot test is to find any unclear or inconsistent questions in the questionnaire so that any necessary revisions can be made to make the questions more understandable and clearer [17-20]. Test-retest reliability will be evaluated by having a subset of participants complete the questionnaire twice. Using this method, the stability of responses over time will be assessed; a high degree of consistency will indicate the questionnaire's reliability.

Reliability analysis methods, such as Cronbach's alpha coefficient for Likert scale items, will be used to evaluate the internal consistency of the questionnaire items [21-26]. By conducting this analysis, it will be ensured that the questionnaire items consistently and reliably measure the intended constructs.

Data Collection & Analysis

In-depth interviews and questionnaire surveys were strategically used as part of the research methodology to acquire perspectives from experts with a strong background in the UK construction sector. These techniques were chosen to guarantee a thorough investigation of the research issue, utilising the knowledge and varied viewpoints of significant stakeholders to enhance the study's empirical base [27-34].

Questionnaire Data

Qualitative methodology will be implemented throughout the collection of data for this research by obtaining willing participants to

complete questionnaires and a handful will be selected to also complete a face-to-face interview. Thirty participants will be contributing to the questionnaire and six will be contributing to the face-to-face interview [35]. Purposive sampling was used in the data collection process to carefully choose participants who could provide insightful information about the research topic.

Section One

The questionnaire that was presented to all complying participants is split into four sections. Section one is comprised of four questions which can be witnessed in the appendices at the end of the research study. The first question in section one was " Could you explain the procedures that your company currently uses for site management during construction projects? ". The reason for including this question is to identify trends in site management. This will facilitate the collection of primary data on a variety of operational practices used in the construction sector [36]. This data can then be compared to identify trends, obstacles, and possible areas for improvement. By offering a thorough understanding of current practices and guiding future recommendations for streamlining site management procedures, this strategy seeks to enhance the research findings.

Question two was " In any of your projects, have drones been used for site management tasks? If so kindly outline the particular uses and advantages you've noticed." The purpose of this question on using drones for site management is to collect first-hand information about the benefits and adoption of drone technology in the construction sector. This information will be useful in identifying the specific applications of drone technology as well as the perceived advantages that industry professionals have seen. In addition to determining how much drone use there is in site management, this investigation aims to identify potential benefits for efficiency, safety, and project management [Figure 1].

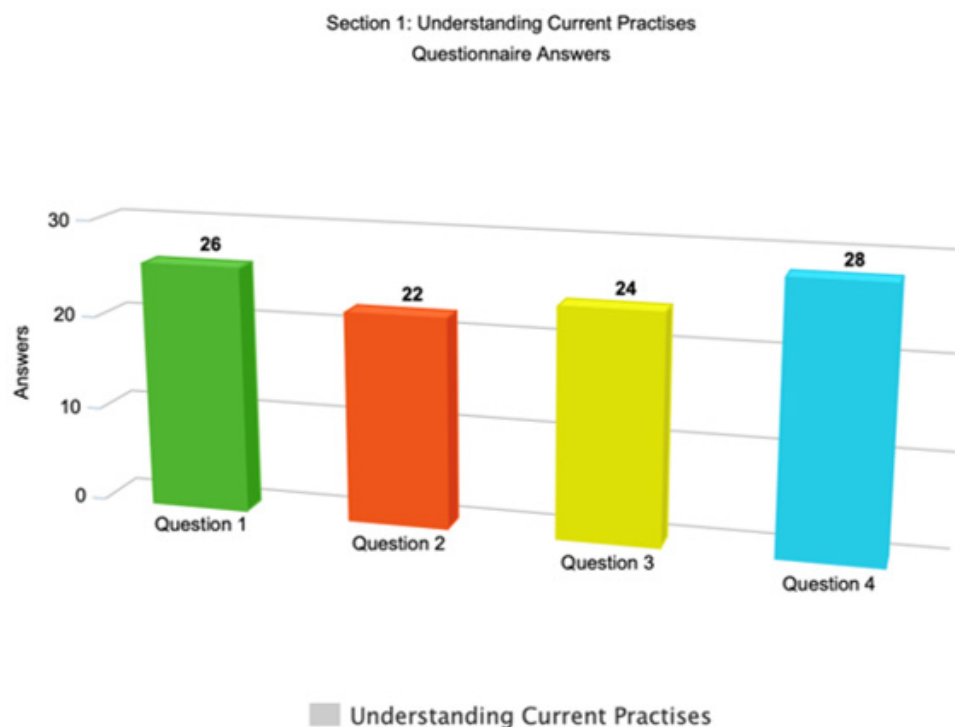


Figure 1: Section 1 Questionnaire Data



The supplied bar chart provides a thorough summary of respondents' opinions regarding UAV applications in the UK housing market, with a focus on site management, progress tracking, and improvements to health and safety. The chart's first section, which corresponds to Question one, describes the wide range of practices that businesses use to manage construction sites. The first section of the chart (Question One) illustrates how many participants answered this question which majority of them answered with the site management being under the contractors liability. This section of the chart provides insightful information about industry standards and common practices, which can be used to identify areas for innovation or improvement in site management techniques as well as common approaches.

Question two data illustrates a lower amount of people answering this as it is more of a technical question. Majority of the participants answered by saying "they were involved in a survey or project that involved a drone of some sort. Question three data shows there was an increase in answers as most participants replied by saying applying biweekly progress meetings. Question four's data was the highest amount of data received as all but two responses were registered.

Majority of participants responded to this question by addressing the drones benefits and how they can be implemented into their projects."

Section Two

Section two of the questionnaire is titled challenges and limitations. The questions are based on why the participants think the implementation of drones in the UK construction industry is limited. Section two is comprised of three questions which can be witnessed in the appendices at the end of the research study. Question one is "What are the primary obstacles or constraints related to the incorporation of drones in construction projects [37-40], specifically concerning site administration and progress tracking?". Incorporating this question helps to recognise and comprehend the difficulties encountered, particularly with site management and progress monitoring. This question seeks to identify potential roadblocks to the successful integration of drone technology by eliciting opinions from experts in the field. This information will help shape strategies to overcome these roadblocks and optimise the advantages of UAV applications in construction projects [Figure 2].

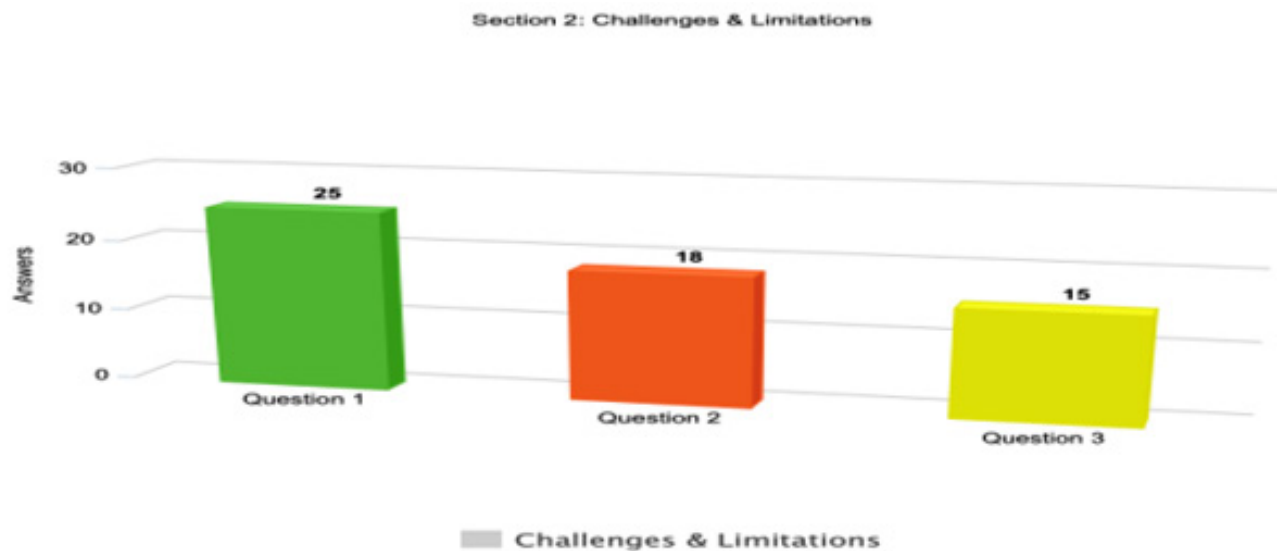


Figure 2: Section Two Questionnaire Data.

Three sections make up the chart, each of which is divided into a major survey question. Taller bars indicate more frequent mentions of the various obstacles cited by respondents for the first question about primary obstacles or constraints related to drone incorporation in construction projects. In a similar vein, bars illustrate various facets of legal and regulatory barriers as well as strategies for mitigating them in the second question about barriers and their resolution. The third and final question examines organisational experiences using drones; bars represent any technical constraints or issues that were encountered.

Question one has the most responses due to the simplicity of the question. One of the participants responses was "Regulatory restrictions, technological limitations, and privacy concerns are frequently the main roadblocks or constraints associated with integrating drones into construction projects for site administration and progress tracking. These obstacles make it difficult to implement the plan smoothly and necessitate cautious manoeuvring to guarantee that drones are used effectively to improve project management and monitoring procedures."

Section Three

Section three of the questionnaire is titled Health & Safety Considerations. The questions are based on how drones can improve health and safety in the UK construction industry. Section three is comprised of three questions which can be witnessed in the appendices at the end of the research study. Question one is "In what ways does your company put health and safety first when it comes to building sites?". In order to reduce risks and enhance the wellbeing of stakeholders and employees alike, it is imperative that the company's commitment to upholding health and safety standards at construction sites be evaluated. This is the purpose of the question. It aims to comprehend particular safeguards and procedures put in place to deal with possible risks and preserve a secure workplace [Figure 3]. The responses to a section of the questionnaire aimed at determining how drones could support health and safety procedures in the UK housing industry are displayed in the bar chart that is attached.



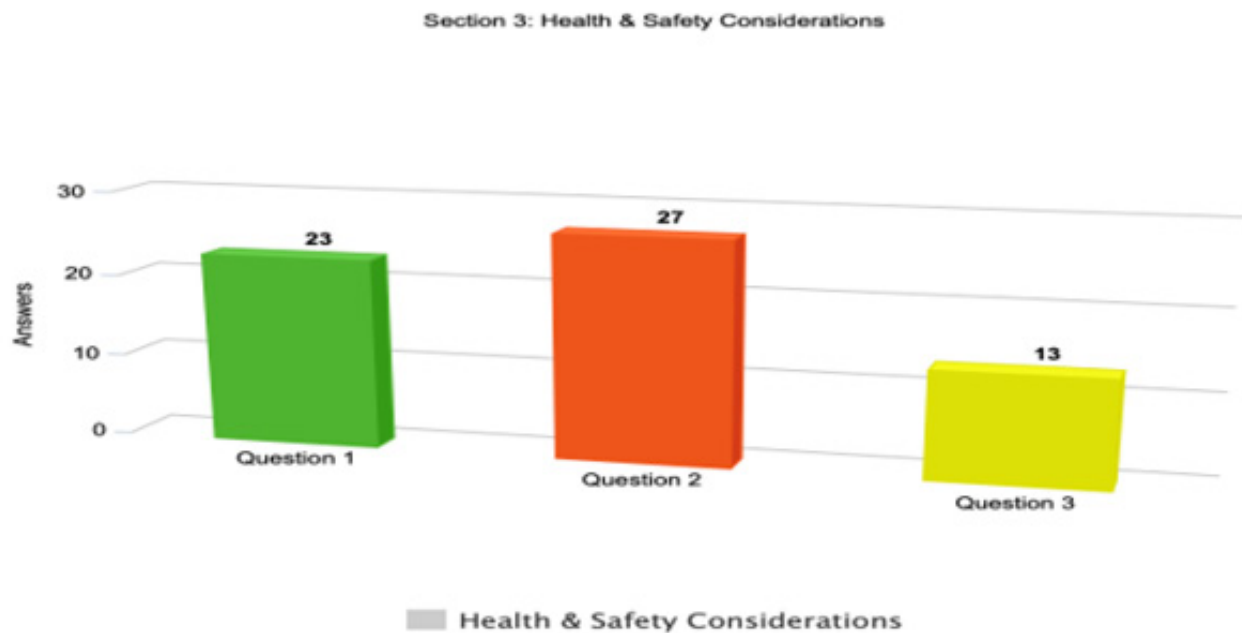


Figure 3: Section three questionnaire data.

The response to question one illustrates that companies are setting a high standard with health and safety considerations prior to construction, demonstrating a proactive approach to risk mitigation and stakeholder and employee well-being. This focus on health and safety comes from a dedication to following legal requirements, following industry best practices, and realising how important it is to promote a safety culture in the construction industry. Due to the increased question two response, this suggests that people are becoming aware of the enormous potential drones have to improve health and safety standards in construction projects. The ability of drones to provide real-time aerial surveillance, enabling prompt identification and mitigation of potential hazards on-site, is one common theme that emerges from these responses.

In addition, the participants emphasised the significance of drones in augmenting data gathering and examination, thereby enabling more precise risk evaluations and knowledgeable decision-making procedures. The survey sample seems to be using fewer drone apps or technologies targeted at enhancing safety and health protocols, based on the low number of responses to question three. Those respondents who did offer insights, however, probably represent early adopters or situations in which such technologies have been used sparingly. Their explanations could provide insightful information about the advantages and practical difficulties of incorporating drone applications for safety in construction environments.

Section Four

Section four of the questionnaire is titled Future Perspective. There are three questions asked in this section and all questions are based on how drones will affect future perspectives in terms of the construction

process and how they will affect certain company's. The first question is "What role do you see drones playing in the UK construction industry going forward, specifically in terms of site management, progress tracking, and health and safety?". In order to inform future strategies and investments in adopting drone technology for construction projects, this question seeks to ascertain respondents' perceptions of the potential impact of drones on various aspects of the UK construction industry, such as progress tracking, site management, and health and safety.

Question two is "Do you think any new technologies or developments in drone technology will have a big influence on construction practices soon?". This inquiry aims to gauge respondents' opinions regarding the possible influence of developing drone technologies on construction methods, assisting in the identification of expected changes in industry standards and the prioritisation of investments or modifications to fully capitalise on these breakthroughs. The aim of this study is to ascertain whether interested parties believe that drones will have a substantial impact on construction methods in the near future.

Question three is "What changes do you see coming in terms of drone adoption in your company and the industry as a whole?". Insights into expected changes in drone adoption within respondent companies and the larger construction industry are sought by this question, which will help with resource allocation and strategic planning to keep up with changing technological trends and maintain competitiveness. The purpose of the questionnaire is to find opportunities for innovation and adaptation within individual organisations as well as the industry at large by understanding stakeholders' perceptions of impending changes in drone usage [Figure 4].



Section 4: Future Perspective

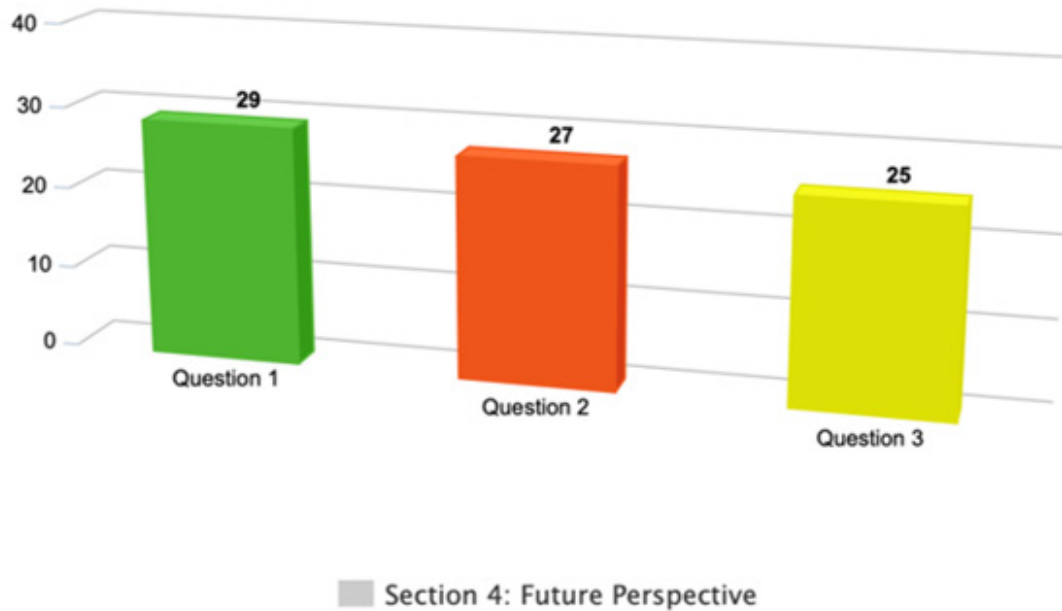


Figure 4: Section four questionnaire data.

The response rates to the three questions about UAV applications in the UK housing sector in Section Four of the questionnaire are displayed in the bar chart that is attached. The proportion of respondents who responded to each question relative to the total number of respondents is shown graphically.

For question One, the high percentage of responses (29 out of 30) suggests that participants are very engaged and interested in talking about the possible uses of drones in different facets of construction. One noted response was *“In the UK construction industry, drones are expected to be a major factor in increasing productivity and safety. This is because they will make site management easier through aerial surveys, allow for real-time progress tracking, and improve health and safety procedures through data collection and remote monitoring. It is anticipated that their capacity to offer in-depth aerial insights and optimise procedures will transform construction methods, resulting in increased efficiency and decreased hazards on construction sites.”*

Interview Data

This section aims to analyse and interpret data collected from interviewing four participants using semi structured interview methods as explained above [41]. All participants interviewed were coming from professional construction consultancy backgrounds such as Drone Pilots, Building Surveyors, Project Managers, Construction Managers, Principal designers, and many more that are currently in practise for some of the major and well-known construction consultancy groups in the UK. The two main objectives to be achieved through these interviews, Firstly: to understand what the participants think are the main advantages and difficulties of incorporating UAVs into the UK

housing industry. Secondly, to find out what they think could happen in the future and what opportunities there might be for UAV use in this industry [Table 1].

Table 1: Traits associated with Drone Application and Form Repetition.

Trait	Repeated Terms	Frequency
Advantages of UAVs	Effective, Site management, Health and Safety, Progress Monitoring	3
Difficulties of UAVs	Privacy Concerns, Regulatory Restrictions, Technical limitations	3
Potential of UAVs	Potential, Huge potential	2

The table presents a concise synopsis of the major recurrent themes that emerged from the text that was provided in relation to the use of UAVs (unmanned aerial vehicles) in the UK housing market. It emphasises the benefits of UAVs, mentioning three times how well they work for progress monitoring, health and safety improvement, and site management.

It also lists recurrent issues, such as privacy issues, legal constraints, and technological limitations, all of which are mentioned once. Professional pilots are highlighted as being crucial to maximising the advantages of UAVs. The attendees convey a positive outlook regarding the capabilities of unmanned aerial vehicles (UAVs) and recognise their noteworthy impact on the progress of the construction sector.



Additionally, distinct domains of involvement, including progress tracking, health and safety, and site management, are outlined and mentioned once each. This concise overview offers an understanding of the viewpoints expressed by the attendees concerning the advantages, difficulties, and possibilities of incorporating UAV technology in the housing industry of the United Kingdom [Table 2].

Table: 2.

Trait	Repeated Terms	Frequency
Effectiveness of drones	Extremely effective, effective	6
Improvement areas	Privacy concerns, regulatory restrictions, technical limitations	3
Professional pilots	Professional pilots, expert pilots	3

The primary themes or characteristics found in the responses about the use of UAVs, or unmanned aerial vehicles, in the UK housing market are succinctly summarised in this table. The "Repeated Terms" column lists the terms or phrases that were frequently mentioned in the responses related to each row, which represents a particular trait or theme. The number of times these terms or phrases appeared in all of the responses is shown in the "Frequency" column. Recurring themes that come to light through this analysis include the usefulness of drones, the value of professional pilots, privacy concerns, legal constraints, and technological limitations. The advantages of drones for progress monitoring, health and safety, and site management are also emphasised. Additionally, it highlights areas that require improvement, such as addressing privacy concerns and regulatory restrictions.

Validity of Findings

A strict approach to data collection that is in line with the goals and context of the research ensures the validity of the research's findings. The decision to employ a variety of techniques, such as UAV technology, surveys, and interviews, improves the validity of the results by obtaining a range of viewpoints and insights. First off, using UAVs to gather data provides a reliable and impartial way to survey construction sites, making it easier to accurately record site conditions, advancement, and safety compliance. In order to make meaningful conclusions regarding the effectiveness of UAV applications in site management and safety improvement within the UK construction industry and housing sector, this method offers real-time visual evidence that can be analysed and interpreted. Subsequently, the incorporation of data obtained from questionnaires and interviews enhances the validity of the results by obtaining perspectives, experiences, and opinions from stakeholders regarding the adoption of UAV technology.

Conclusion

This research explores the possible uses of unmanned aerial vehicles (UAVs) in the housing industry in the United Kingdom (UK), with a particular emphasis on site management, progress tracking, and improving health and safety procedures during construction. In order to better understand how UAV technology can transform conventional construction methods, this study will examine the current state of UAV adoption in construction, including its advantages, disadvantages, and

regulatory considerations. Both the advantages and disadvantages of incorporating UAVs into construction projects are examined through the analysis of case studies and practical applications, offering insights into their effects on project schedules, project outcomes overall, and cost-effectiveness. The study also explores stakeholder perceptions, and the skill sets, and training requirements required for the widespread use of UAVs in construction.

Reintroduction to the Methodology

This Research's third Research explores the methodological framework used to investigate the uses of unmanned aerial vehicles (UAVs) in the UK housing market. Using a mixed-methods approach that combines qualitative and quantitative research techniques, the Research concentrates on improvements in health and safety, progress tracking, and site management in the construction sector. While the quantitative part consists of distributing structured questionnaires to professionals and regulatory bodies, the qualitative component uses techniques like focus groups, interviews, and observation to obtain nuanced insights from housing industry stakeholders. This study aims to provide a thorough understanding of the many opportunities and challenges associated with UAV implementation in construction projects by utilising both qualitative and quantitative methodologies.

The section on qualitative methodology highlights the depth of understanding that qualitative methods offer when examining intricate issues like safety protocols and progress tracking. Notwithstanding, the study acknowledges certain limitations, including contextual specificity and time-consuming data collection. On the other hand, the section on quantitative methodology emphasises the objectivity and statistical precision provided by quantitative approaches, which facilitate the recognition of noteworthy patterns and correlations in the data. However, the Research also recognises the drawbacks of quantitative research, namely its propensity to oversimplify complicated phenomena and its constrained ability to conduct in-depth analysis. In the end, the Research supports the choice of a mixed-methods approach by emphasising its capacity to strengthen validity, triangulate results, and offer a comprehensive viewpoint on UAV applications in the UK housing sector [42].

Recommendations

Expanding on the groundwork established by this Research, there exist multiple research directions that could enhance our comprehension of UAV (Unmanned Aerial Vehicle) implementations in the housing sector of the United Kingdom. Examining how drone use in building projects affects environmental sustainability is one possible research topic. "Environmental Impact Assessment of UAVs in UK Housing Construction" is a potential title for a Research that examines the energy consumption, ecological implications, and carbon footprint of drone operations. This could provide valuable information about the sustainability of drones overall and their potential to reduce environmental impacts in the housing sector. By putting a number on the advantages and disadvantages of drone technology for the environment, this study may help decision-makers make better choices and encourage the use of environmentally friendly building techniques. Yang, Y [43].

In conclusion, future studies could look into the environmental sustainability of UAVs, how they integrate with BIM systems, and the legal and regulatory ramifications of drone operations in the UK



housing market. Researchers can further knowledge and innovation in UAV applications by tackling these subjects, which will ultimately benefit the housing construction sector and its stakeholders.

The integration of Unmanned Aerial Vehicles (UAVs) with Building Information Modelling (BIM) systems to improve project planning and execution is a promising avenue for future research. In order to improve site management, progress monitoring, and overall project efficiency, a Research titled "Integrating UAVs and BIM for Optimised Housing Construction Projects in the UK" could look into the ways that drones and BIM software work together. Through an examination of the technologies' interoperability and an evaluation of their effects on project outcomes, this study may provide useful recommendations for optimising the advantages of UAV-BIM integration and propelling digital transformation in the home building sector. Chen, Y [44].

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