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The Perception of Construction Industry Players on Drone Technology: Impact on Project Delays and Work Quality

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Abstract

Introduction/Main Objectives: This study aimed to systematically investigate the perception of construction industry players regarding the effectiveness of drone technology in mitigating project delays and improving work quality on construction sites.

Background Problems: The global construction industry faces persistent challenges from project delays and work quality variations, leading to financial losses. Despite the growing adoption of drone technology as a monitoring solution, there is a lack of empirical evidence on how industry players themselves perceive its effectiveness in addressing these core issues.

Research Methods: A quantitative survey method was employed, targeting a sample of construction professionals (project managers, engineers, contractors) in Southern Malaysia. Data were analyzed using descriptive statistics to measure the intensity of industry perception.

Finding/Results: Results showed an overwhelmingly strong positive perception. The mean score for perceived effectiveness in reducing project delays was 4.26. The mean score for perceived impact on improving work quality was 4.26 (based on a 5-point Likert Scale).Familiarity and hands-on experience with drone technology led to more informed and nuanced evaluations of its benefits.

Conclusion: Construction industry players view drone technology as a highly valuable and effective intervention for enhancing both project timeliness and quality. The study provides critical, evidence-based justification for its strategic adoption, offering clear guidance to construction firms and policymakers on maximizing the technology's benefits to address key sector performance challenges.

Keywords: Drone Technology, Construction Management, Project Delays, Work Quality, Industry Perception

Introduction

The construction industry in Malaysia has been facing considerable challenges regarding project delays and work quality, exacerbated by factors such as inefficient project management, material shortages, and ineffective communication among stakeholders. These persistent issues not only lead to financial losses but also affect the overall credibility and productivity of the construction sector in the country (Sambasivan & Soon, 2007). Recent advancements in drone technology, including Unmanned Aerial Vehicles (UAVs), are emerging as a promising solution aimed at alleviating these challenges through enhanced project monitoring and resource management capabilities (Alsamarraie et al., 2022; Moskovchenko & Mishuk, 2025).

Emerging research highlights the potential of drone technology to transform traditional construction practices by offering real-time data collection, site inspections, and improved safety measures (Jacob-Loyola et al., 2021; Namian et al., 2021; Moskovchenko & Mishuk, 2025;). The accessibility and cost-effectiveness of drones provide construction professionals in Malaysia with innovative ways to conduct surveys and monitor ongoing construction activities, ultimately contributing to more efficient project management and oversight (Alsamarraie et al., 2022; Namian et al., 2021; Ullah et al., 2018). The effective employment of drones under governmental regulations is believed to offer numerous benefits, including reduced lead times and improved quality of work, which are particularly critical given the high stakes of delivering complex construction projects on schedule (Alsamarraie et al., 2022).

Moreover, previous studies have shown that integrating drone technology with Building Information Modelling (BIM) can substantially improve the accuracy of project execution, enabling more precise planning, monitoring, and quality control that helps minimise unexpected delays (Ojeda et al., 2024; Duarte-Vidal, 2021). The influence of UAVs spans all phases of construction, from pre-construction to project completion supporting proactive management strategies that address and reduce risks related to time overruns and construction defects (Almusaiabi & Naimi, 2023). Despite these technological advancements, the implementation of drones in Malaysia's construction sector continues to encounter challenges, such as regulatory limitations and concerns about safety and interaction with on-site workers (Namian et al., 2021). As UAVs become increasingly accessible, their use is anticipated to grow within project management, promoting more efficient workflows, improved safety measures, and enhanced data accuracy throughout construction activities (Mottaeva, 2024). Therefore, understanding industry players' perceptions of drone technology is essential to creating an environment that supports innovation and improved project performance.

As the Malaysian construction industry continues to evolve, exploring perceptions of drone usage is crucial to identifying areas for improvement and promoting adoption. This study aimed to systematically examine industry perceptions by focusing on how drone technology influences two key project outcomes: the reduction of project delays and the impact on work quality at construction sites in the Southern of Malaysia. By addressing both the benefits and hurdles associated with UAV integration, this research seeks to support the advancement of drone technology in the Malaysian construction environment, ultimately contributing to enhanced project efficiency and effectiveness.

Research Methods

The study utilized a quantitative, non-experimental survey design to collect data on industry professionals' perceptions. The primary data collection instrument was a structured, self-administered questionnaire. This instrument was distributed online using Google Forms to ensure efficiency in reaching a wide professional audience and in subsequent data extraction. The questionnaire was organized into three distinct sections which are Section A: Demographic and Experience Profile, Section B: Perception of Drone Technology Impact on Project Schedule Performance (Delays) and Section C: Perception of Drone Technology Impact on Work Quality. All perceptual items in Sections B and C were measured using a 5-point Likert scale, anchored from 1 = Strongly Disagree to 5 = Strongly Agree, which is a standard psychometric approach for measuring attitudes and perceptions in research.

The initial draft of the questionnaire was reviewed by a panel of Subject Matter Experts (SMEs). A pilot test was executed involving a convenience sample of 20 respondents who matched the characteristics of the target population. Feedback was meticulously collected and used to perform minor refinements, ensuring the final instrument was fit for purpose. The internal consistency reliability of the scales (Sections B and C) was formally assessed using Cronbach's Alpha following the pilot test. Computed Cronbach's Alpha value for the scales was 0.89. This value is well above the generally accepted minimum threshold of 0.70 for acceptable reliability in social science research, confirming that the items within the instrument scales were highly correlated and reliably measured the same underlying constructs.

Data gathered from the structured questionnaire was analyzed using the IBM SPSS Statistics software. The analysis proceeded in two main stages: descriptive and inferential statistics. Descriptive statistics specifically mean, standard deviation, frequency, and percentage were calculated. These statistics were used to Summarize the demographic and professional profiles of the respondents (Section A) and provide a general overview of the respondents' central tendencies and dispersion of scores (mean and standard deviation) regarding their perceptions of drone technology (Sections B and C).

Inferential statistical tests were employed to test the relationships and differences between key variables:

Correlation Analysis
Pearson's product-moment correlation coefficient was used to quantitatively examine the strength and direction of the linear relationship between the core perceptual variables, specifically the perception of the impact on project schedule performance (delays) and the perception of the impact on work quality.

Group Comparison Tests
One-way ANOVA was utilized for comparing mean scores of perceptions of the impact on project schedule performance (delays) and the perception of the impact on work quality across three or more groups for years of working experience and drone handling experience at site.

Result

The results of the study are based on 110 questionnaires administered to the respondents. Table 1 presents the demographic and experience profiles of the participants. Among them, 15 were project managers, 26 were engineers, 21 were supervisors, 28 were assistant engineers,

and 20 were contractors, representing a range of working experience durations. The respondents were primarily from the southern region of Malaysia, with 48% from Melaka, 29% from Johor, and 23% from Negeri Sembilan. The findings also show that 46% of respondents handled drones only occasionally, compared to 27% who frequently operated drones and 27% who had never handled a drone on-site.

Table 1 Profile of the respondents

Respondents Demography and Profile	Frequency	Percentage
Gender		
Male	70	63.6
Female	40	36.4
Total	**110**	**100**
Age		
<25 years	38	34.5
25-35	38	34.5
35-45	22	20.0
45-55	12	11.0
Total	**110**	**100**
Role in Project		
Project Manager	15	13.6
Engineer	26	23.6
Supervisor	21	19.1
Assistant Engineer	28	25.5
Contractors	20	18.2
Total	**110**	**100**
Duration of Working Experience		
>5 years	65	59.1
5-10 years	29	26.4
10-15 years	11	10.0
>15 years	5	4.5
Total	**110**	**100**
State of Working		
Johor	29	26.4
Melaka	53	48.2
Negeri Sembilan	28	25.4
Total	**110**	**100**
Types of industries		
Consultant	15	13.6
Contractor	70	63.6
Developer	25	22.8
Total	**110**	**100**
Experience of drone handling at site		
Yes, frequently	27	24.5
Yes, occasionally	46	41.8
No, never	37	33.6
Total	**110**	**100**

Source :Author's Data,2025

Table 2 shows the descriptive analysis indicates that respondents hold a consistently positive perception of drone utilisation in project monitoring, with all mean scores exceeding 4.00. The highest agreement is observed for the statements that drones provide faster information (M = 4.37, SD = 0.804) and enhance the accuracy of progress tracking (M = 4.36, SD = 0.700), reflecting strong confidence in the technology's ability to deliver timely and reliable site data. Respondents also agreed that drones support schedule monitoring, facilitate coordination through shared visual information, and contribute to improved documentation and transparency. Additionally, drones are perceived to reduce the need for repeated site inspections and assist in monitoring material deliveries, although with slightly more variability in responses. Overall, the results demonstrate that construction industry players strongly recognise the value of drones in improving monitoring efficiency, enhancing communication among project teams, and ultimately helping to minimise project delays.

Table 2 Perception of drone technology impact on project schedule performance (delays)

No	Item	Mean	SD
1	Drones help monitor site progress in real-time.	4.33	.920
2	Drones contribute the accuracy of progress tracking.	4.36	.700
3	Information received from drone is faster.	4.37	.804
4	Drone usage supports project teams in schedules monitoring against the Gantt chart.	4.25	.882
5	Using drones can contribute to better project monitoring which avoids irrelevant delays.	4.31	.854
6	Drone usage provides shared visual information that supports coordination between project teams.	4.29	.828
7	Drone usage contributes to better documentation and transparency in project progress.	4.18	.792
8	Drones support the monitoring of material deliveries and placement, especially for items that do not require heavy transportation, helping to save time on site.	4.07	.993
9	Drone usage can reduce the need for repeated site inspection and also save project time.	4.15	.947

Source :Author's Data,2025

The descriptive results reveal a strong positive perception of drone utilisation in enhancing work quality, with all items recording mean scores above 4.00. Respondents strongly agreed that drones provide images and videos that support clear quality assessment (M = 4.44, SD = 0.684; M = 4.42, SD = 0.734), indicating high confidence in the visual accuracy and reliability of drone-generated evidence. Although items related to early defect detection and monitoring workmanship recorded slightly lower means (M = 4.09 for both), the values remain high, reflecting a generally positive view. Overall, the findings indicate that construction practitioners recognise drones as valuable tools for improving visual inspection, enhancing safety, strengthening communication, and supporting overall quality management in construction projects.

Table 3 Perception of drone technology impact on work quality

No	Item	Mean	SD
1	Drones deliver images that support project quality observation.	4.44	.684
2	Drones help detect construction defects early.	4.09	.924
3	Drones help ensure compliance with construction specifications.	4.13	.920
4	Drones allow better monitoring of workmanship quality.	4.09	.944
5	Drone inspections provide additional perspectives that may help identify construction errors.	4.25	.747
6	Drones improve safety, which indirectly supports the consistency of work quality.	4.16	.894
7	Drone videos provide clear evidence for quality assessments.	4.42	.734
8	Drones allow better supervision in hard-to-reach areas.	4.36	.811
9	Drones improve communication of quality issues among stakeholders.	4.35	.771
10	Drone documentation supports post-construction quality reviews.	4.35	.747

Source :Author's Data,2025

The correlation coefficient between Project Delay and Work Quality is 0.790. It shows a positive correlation means that as the perception of drones' positive impact on reducing project delays increases, the perception of their positive impact on improving work quality also increases. Since the p-value (<.001) is much smaller than the standard significance level ($\alpha = 0.05$), the correlation is highly statistically significant. The perception of benefits in schedule performance is linked to the perception of benefits in work quality.

Table 4 Correlation of perception of drone technology impact on project schedule performance (delays) and work quality

		Project_delay	Work_Quality
Project_delay	Pearson Correlation	1	.790***
	Sig. (2-tailed)		<.001
	N	110	110
Work_Quality	Pearson Correlation	.790***	1
	Sig. (2-tailed)	<.001	
	N	110	110

**Correlation at 0.02 level (2-tailed)

Source :Author's Data,2025

The One-Way ANOVA analysis was conducted as in Table 5 to examine whether working experience influences respondents' perceptions of drone technology in relation to project delay and work quality. For the perception of drone impact on project schedule performance (delays), the ANOVA results show that the difference in mean scores across the four working experience groups was not statistically significant, $F(3,106) = 1.926$, $p = 0.130$. Since the p-value is greater than the significance level of 0.05, the findings indicate that respondents, regardless of their years of experience in the construction industry, generally share similar views on the extent to which drone technology helps reduce project delays. This suggests that the benefits of drones in improving timeliness and monitoring efficiency are perceived consistently across experience levels.

In contrast, the results for the perception of drone impact on work quality demonstrate a statistically significant difference among the experience groups, $F(3,106) = 4.087$, $p = 0.009$. With the p-value falling below the threshold of 0.05, it can be concluded that working experience plays a meaningful role in shaping respondents' views on how drones enhance work quality. This implies that professionals with different levels of experience evaluate the contribution of drone technology to workmanship, defect detection and quality assurance differently. In the Malaysian construction context, this finding highlight that more experienced practitioners may have deeper insight or greater exposure to quality-related processes, thus influencing how they assess the value of drones in supporting construction quality management.

Table 5 Relationship between perception of drone technology impact by duration of working experience

Source of variation		Sum of Squares	Df	Mean Square	F	Sig.
Project Delay	Between Groups	2.845	3	.948	1.926	.130
	Within Groups	52.188	106	.492		
	Total	55.033	109			
Work Quality	Between Groups	4.891	3	1.630	4.087	.009
	Within Groups	42.286	106	.399		
	Total	47.177	109			

Source :Author's Data,2025

Table 6 shows the relationship between perception of drone technology impact by duration of drone handling experience at site. The One-Way ANOVA results demonstrate that drone experience plays a significant role in shaping professionals' perceptions of drone technology, particularly in relation to project delay. The analysis shows a highly significant difference across experience groups, $F(2,107) = 9.539$, $p < 0.001$, indicating that the null hypothesis of equal mean perceptions is strongly rejected. This finding suggests that individuals with varying levels of drone experience tend to assess the impact of drones on project scheduling

differently. In practice, professionals who are more familiar with drone operations may have a clearer understanding of the technology's capabilities in improving monitoring efficiency, streamlining site inspections, and reducing unnecessary delays. Thus, drone experience emerges as an important factor influencing how respondents evaluate the role of drones in managing project timelines.

Similarly, the analysis for work quality shows a statistically significant difference among the drone experience groups, $F(2,107) = 5.619$, $p = 0.005$, indicating that the null hypothesis is rejected. This implies that respondents' perceptions of drones in enhancing work quality vary according to their level of experience with the technology. Professionals with greater drone exposure may better recognize how drone-generated data supports defect detection, visual documentation, workmanship assessment, and compliance monitoring. These results underscore the importance of practical experience in shaping more informed and nuanced evaluations of drone applications in construction quality management.

Table 6 Relationship between perception of drone technology impact and duration of drone handling experience at site

Source of variation		Sum of Squares	Df	Mean Square	F	Sig.
Project Delay	Between Groups	8.328	2	4.164	9.539	<.001
	Within Groups	46.705	107	.436		
	Total	55.033	109			
Work Quality	Between Groups	4.484	2	2.242	5.619	.005
	Within Groups	42.693	107	.399		
	Total	47.177	109			

Source :Author's Data,2025

Discussion

Respondents acknowledged that drones effectively support schedule monitoring, facilitate coordination via shared visual information, and improve documentation and transparency. The findings also collectively indicate that construction industry players recognize drones as valuable tools for improving the efficiency and effectiveness of visual inspection processes, ultimately enhancing safety, strengthening project communication, and contributing significantly to overall quality management in construction projects. According to Kazaz et al. (2012), one of the primary contributors to delays in construction is inefficiency in communication and coordination among stakeholders. Drones can bridge this gap by providing up-to-date information that enhances communication. For instance, real-time aerial views shared among team members can lead to quicker decision-making, thereby minimizing delays significantly. Moreover, UAVs support project progress monitoring and documentation through aerial surveys, facilitating the creation of accurate and timely reports (Sentosa et al., 2023).

The observed correlation coefficient of 0.790 between perception of drone technology impact project delay and work quality in the context of drone technology signifies a strong positive relationship. This implies that as construction industry players perceive an increase in the positive impacts of drones on reducing project delays, they concurrently recognize a corresponding enhancement in work quality. The statistical significance of this correlation is underscored by a p-value of less than 0.001, which is well below the conventional threshold of $\alpha = 0.05$, indicating that the relationship is highly significant and not due to random chance. Drones contribute to improved scheduling accuracy by offering real-time data and better site visibility, which can lead to more informed decision-making processes in construction projects. Leveraging technology in project scheduling is crucial to improving construction efficiency and strengthening schedule performance. Therefore, the importance of effective scheduling practices in construction projects is supported by Sulbaran (2023).

The findings indicate that respondents, regardless of experience, widely recognize drone technology as effective in reducing project delays and enhancing monitoring efficiency, a view supported by Moskovchenko and Mishuk (2025) who highlight UAVs' superior efficiency in construction monitoring. However, perceptions of drones' contributions to workmanship, defect detection, and overall quality are influenced by professional experience, aligning with Eiris et al. (2018). They note that more experienced professionals better appreciate UAVs' potential in quality management. In the Malaysian context, this suggests that while the impact on project timeliness is universally acknowledged, quality-related benefits require deeper insight or practical exposure, leading to varied assessments based on experience.

The responses also strongly suggest that individuals with greater familiarity in drone operations possess a more refined understanding of the technology's ability to enhance monitoring efficiency, streamline site inspections, and reduce unnecessary delays. However, construction companies continue to face challenges such as limited operational familiarity, insufficient technical knowledge, and concerns related to privacy and regulatory compliance (Yahya et al., 2021; Namian et al., 2021). Overall, these findings highlight the critical importance of practical experience in shaping more informed and nuanced evaluations of drone applications, particularly in managing project timelines and ensuring construction quality.

Conclusion

The findings of this study show that respondents perceive drones as effective tools for enhancing schedule monitoring, improving coordination through shared visual information, and strengthening documentation and transparency in construction projects. These perceptions align with existing literature, which highlights communication inefficiency as a major contributor to project delays and drones have been shown to address this issue by providing real-time data that supports quicker and more informed decision-making. The strong positive correlation observed indicates that as construction industry players recognise the ability of drones to reduce project delays, they concurrently acknowledge improvements in overall work quality, supporting the importance of technology-driven scheduling practices. While perceptions of drones' impact on project timeliness are consistent across all experience levels, differences emerge in how respondents view their contribution to workmanship, defect detection, and quality assurance suggesting that practical experience plays a meaningful role in shaping deeper understanding of drone-enabled quality management. Overall, the results highlight that familiarity and hands-on exposure to drone technology contribute to more informed and nuanced evaluations of its effectiveness in improving monitoring efficiency, streamlining site inspections, and enhancing both scheduling performance and construction quality in the Malaysian context. Finally, future research should further investigate advanced drone applications such as AI-assisted defect detection and BIM integration to maximise the technology's potential in improving scheduling performance and construction quality in the Malaysian context.

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