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Research Article

The Potential and Readiness of Unmanned Aerial System (UAS) Implementation in the Development of Construction Work

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ABSTRACT

Unmanned aerial system technology is being used more and more frequently in the construction sector today. Over the past ten years, unmanned aerial systems (UAS) have developed into cutting-edge military technology and readily available consumer goods. Unmanned aerial system technology is being used more and more frequently in the construction business today. Drone applications are shifting more and more toward productive remote procedures that can be carried out in a variety of building industry settings. Remote sensing tools for Unmanned Aerial Systems can be used to examine and assess the status of ongoing building construction projects. This research will let building construction professionals see how remote sensing technology may replace human paper-based supervision and an unorganized database for the existing traditional construction job progression method.

1. Introduction

In the past, monitoring building progress required a lot of labor. Most often, daily or weekly reports are utilized to track the amount of work completed on site. These reports are adaptable and include a variety of information, such as the availability of resources, potential risks, inventory checklists, and incidents, but they do not gather geometric three-dimensional (3D) data from the completed project. [1]. The manual techniques currently in use for progress measurement are time-consuming and prone to error. [2]. Furthermore, a project manager devotes 30 to 50 percent of his or her time on data processing and analysis. Effective project progress monitoring requires accurate and timely data gathering, analysis, and visualization of a project's as-built status. This added strain leads to more errors as project teams rush to synthesize data and make timely effective project control decisions. Accurate and regular progress reporting on construction projects helps the project team to be aware of the project's state and make informed decisions. [3] mentioned that progress reporting of the construction project is a crucial component of construction project management. Through a regular and precise status report, the project team can understand how the project proceeds, budgets are respected, essential quality is achieved, and safety precautions are followed. This knowledge guides them via informed decisions and corrective action. There is a positive relationship between performance and the amount of information a person is exposed to. Individual performance "declines quickly" when too much information is supplied to the person. Furthermore, traditional progress reports provide a snapshot of development over time (bi-weekly, weekly, or monthly), but management must comprehend the project's progress trend up to the evaluation date in order to make educated decisions. Current techniques of monitoring progress are not as exact, consistent, predictable, or quick to offer effective management options to keep a project on track. The most commonly used methods are manual non-spatial data collection processes, such as checklists and daily reports containing

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a large amount of visual data from the building site that can be acquired in a short period of time. There may be significant delays before foremen are examined on a daily or weekly basis and any relevant information is sent to the parties concerned. The entire method may result in missed corrective actions and timetable delays.

2. Unmanned Aerial System (UAS) technology potential

Additionally, unmanned aerial system (UAS) technology has been gradually embraced by the architecture, engineering, and construction (AEC) sector. UASs have been used in a variety of AEC applications, including building inspection and traffic monitoring [4], and landslide surveillance [5] to the preservation of heritage monuments [6], [7] as well as city planning [8]. Due to the benefits associated with their ability to penetrate risky or inaccessible areas and complete tasks safely and effectively, the usage of UAS, particularly in the construction industry, has increased exponentially. [9]. Today, a drone is known by several names, comprising Remote Pilot (RPA), Unmanned Aerial Systems (UAS), Unmanned Aerial Vehicles (UAV), Unmanned Aircraft Systems (UAS), and Remotely Operated Aircraft (ROA). Prior until now, drone or unmanned aerial system technology was mostly developed for military uses. Unmanned Aerial Systems are powered aircraft without a human pilot, allowing either autonomous flight or remote-control operation. With the use of remote operations, this system offers prospects for an unmanned aerial system. Due to the development of both cutting-edge airplane hardware and readily available consumer electronics over the past ten years, unmanned aerial systems [10].

Unmanned aircraft have grown in importance as a study field in recent years. Due to their mechanical simplicity, they are presently utilized more and more in civil applications like surveillance and infrastructure inspection. The ability of aerial vehicles different speeds of flight, they stay in place and fly over a spot, perform manoeuvres close to barriers, and fly indoors and outdoors, whether fixed or loitering, distinguishes them from one another often. These qualities make them perfect for human substitution when human engagement is risky, challenging, expensive, or draining.[11]. Prior studies have looked at the utilization assessment of building systems using drone deployment and workflow, 3D model reconstruction, and anomaly detection image data analytics.

The employment of Unmanned Aerial Systems has increased steadily, and it is now recognized as a standard analytical technique for the gathering of images and other information as needed in a particular region of interest. [12] Drone technology is described as being able to collect data on the construction site quickly and monitor on-site build large-scale in real time more frequently. Drones are one of the current technologies that are considered suitable to replace the monitoring of progress done manually. Due to the constant development of new applications, innovations, and capacities in response to the environment, technology will continue to infiltrate a range of industries.

3. Technology Readiness Index (TRI)

The ability to adopt and use new technology to achieve goals in both personal and professional life is referred to as technology readiness. Development may be thought of as a general state of mind caused by a mix of mental facilitators and inhibitors that collectively determine a person's propensity to adopt new technology. The scale of things should be simpler to include in analysis questionnaires. Optimism, creativity, discomfort, and insecurity are the other four variables on the first scale [13]. The operational environment has significantly enhanced as a result of technological improvements. In addition, a few other factors that promote technological growth are the mental challenge, recognition, expanded body of knowledge, expanding global population, and advancing economy. Additionally, technology will change over time, and establishment the new version of the Technology Readiness Index (TRI) has been created. as a result of the quick development of new technology. Thus, the four components of Parasuraman's technique are optimism, innovation, pain, and security. The technical landscape has changed, and TRI has been modified to reflect these changes while also being made more efficient. As a result, it will be simpler to include the scale of items in analytical questionnaires. Four variables are included in the first scale as well: optimism, inventiveness, discomfort, and insecurity. [14]. A favorable perspective of technology and the conviction that it improves people's power, flexibility, and efficiency make up the optimism factor. In general, it expresses technology's upbeat sentiments. While the predisposition to be a leader in ideas and a pioneer in technology is what is meant by the innovativeness component. This dimension generally measures how much people believe they are at the forefront of technological adoption. The uneasy feeling is similar to a feeling of confusion and a perceived loss of technological authority. In the case of technology, this component involves people's experiences and typically assesses their level of dread. As a result, the lack of technology and doubt about its viability constitute the factor of insecurity. This element focuses on possible objections that individuals can have to technologicallybased transactions.

The use of robots and construction automation technically takes the same path, with an emphasis on putting together and installing parts using these technologies. Any nation's aware to adopt construction automation and robotics technologies can be assessed in terms of expenses or financial commitments, the availability of parts and equipment, compatibility with present building activity and practices, the labour market, the nature of the construction process, and market culture are all examples of technological know-how and equipment.

4. Methodology

In this study, a quantitative methodology was used. a five-point Likert scale self-administered questionnaire with closed-ended items. The final survey has through the initial evaluations, which include validity and reliability testing. By selecting a panel of five experts to pre-test and analyze the collection of questions, content validity is employed. They are made up of three professionals with project management expertise and two academics who are teachers and researchers in the field of construction and safety management at universities. While the pilot survey yielded 30 useable replies, using Cronbach's Alpha coefficients, this study's internal consistency and data dependability were verified. It was discovered that the questionnaire's Cronbach's alpha coefficient was more than 0.7, which was considered to be a reliable level for gathering quantitative data. As the demographic sample for this study is known, a simple random sampling method was used to distribute the final survey. 74 construction companies from Pulau Pinang's overall G7 contractor-grade are the study's targeted demographic. In Malaysia, Pulau Pinang is a state that is favourably developing and has a large number of buildings. 66 of the needed samples were successfully collected and may be used for analysis. In order to accomplish the study goal, descriptive analysis was used to analyze the data gathered using IBM SPSS Statistical Software.

5. Results and Discussion

5.1 The possibility and readiness of implementing unmanned aerial systems in the development of construction projects

Table 1 displays the means and standard deviation for each variable depending on the Unmanned Aerial System technology's capability factor. The factors are Building Factor (mean=4.41, sd.=0.47), Control System (mean=4.60, sd.=0.34), Data Collection (mean=4.47, sd.=0.44), Safety Element (mean=4.43, sd.=0.44), and Visual Element (mean=4.38, sd.=0.52). Additionally, for the readiness factors of using Unmanned Aerial System technology, the average values for optimism, innovation, discomfort, and insecurity are 3.06, 0.95, 3.12, and 1.37, respectively. The suggestions by were utilized to interpret the mean value score of the variables employed in this investigation [15].

Table 1. Descriptive Analysis

Variables	Mean	Standard Deviation	Mean Value Score Interpretation
Capabilities Factors			
Control System	4.60	0.34	High
Data Collection	4.47	0.44	High
Safety Element	4.43	0.44	High
Building Factor	4.41	0.47	High
Visual Element	4.38	0.52	High
Readiness Elements			
Optimism	3.56	0.44	High
Innovative	3.24	1.38	Moderate
Discomfort	3.06	0.95	Moderate
Insecurity	3.12	1.37	Moderate

Note: The mean value categorized into three levels: low = 1.00 to 2.66; moderate = 2.67 to 3.33; and high = 3.34 to 5.00.

Considering the outcome shown in the Table 1, consequently, Unmanned Aerial System technology is now more competent and has a wide variety of applications on building sites as a consequence of recent technological advancements. In addition, using unmanned aerial systems at work reduces costs and time spent on tasks while increasing safety in comparison to more traditional techniques. However, it is important to emphasize that there are many elements that might hinder the adoption of the Unmanned Aerial System and explain the findings of a moderate association. Unmanned aerial vehicles' overall financial struggles might, however, have an impact. Regulation, upkeep, education, insurance, image processing software, and navigation software are all rather pricey for unmanned aerial vehicle operations. In order to establish an effective plan to increase the degree of readiness of Unmanned Aerial System implementation in the evolution of building activity, the detection of possible complicated aspects should thus require additional input.

6. Conclusions

In conclusion, the building industry is essential to the development of the country's economy. Construction projects must be completed on schedule; any delays might incur considerable costs that needs to be stopped. To achieve this, construction activity must be periodically assessed to ensure that deadlines and goals are met on schedule. The creation of a system for tracking progress is a labour-intensive process without which the project risked becoming disorganized. Unmanned aerial systems are recognized as an effective rating and incentive mechanism for raising standards. The use of employing unmanned aircraft systems (UAS) can be a replacement for the traditional construction work progress at site, which is consistent with the fourth industrial revolution (IR 4.0) period of digital construction.

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