

## Reviewing Challenges of Drone Technology Application Amongst Contractor G7

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**Abstract:** Drones are considered a new and innovative technology. Therefore, many fields are showing increasing interest in utilizing drones, such as mapping in mining and surveillance in transportation. The use of drones in the field of construction is relatively less. Malaysian construction industry still suffers with many problems and being associated with low quality, low productivity, unskilled, project delays, poor maintenance, non-conductive and high accident rates. Even though challenges faced by the construction industry in construction stage are always being widely studied, there are still inadequate studies that provide an overview of issue regarding the using of drone in Malaysia construction industry. Thus, this research aims to study the application of drone in construction, the challenges of the drone implementation and solution to resolve challenges faced by contractor G7. The approach of this study which is qualitative method by doing interviews with seven respondents representing seven different G7 company that located in Klang Valley (Selangor & Wilayah Persekutuan Kuala Lumpur). The data receive from the respondents are analysed using thematic analysis method. The results of this study expressed that drone are most implemented in construction to help reporting purposes. Besides, the most common challenges revealed by this research are technical knowledge. Proper planning and training either provided by the company or authorities are necessary to resolve the challenges. Therefore, all parties including government, company/workers, personnel shall take initiatives to resolve the challenges faced

**Keywords:** Drone technology, implementation, challenges, construction industry

## 1. Introduction

Drones are considered a new and innovative technology. Therefore, many fields are showing increasing interest in utilizing drones, such as mapping in mining and surveillance in transportation. The construction industry has been a slow adopter of latest technologies (Li & Liu, 2018). However, drones have potential to facilitate construction in many aspects through the construction cycle. There is research has been carried out by Jaafar, Abdul Aziz, Ramayah, and Saad (2007) about Integrating information technology in the construction industry: Technology readiness assessment of Malaysian contractors. However, this research has limitation, and it is lacking on specify drone technology extensively. Hence, the study of drone technology application in construction project is important. In Malaysia, there are numerous of studies in the field of construction projects development. Even though challenges faced by the construction industry in construction stage are always being widely studied, there are still inadequate studies that provide an overview of issue regarding the using of drone in Malaysia construction industry. Thus, this research aimed to determines how the construction players can implement drone in the construction projects, what is the challenges that construction players may face and determine the solution to resolve challenge that may be faced to implement drone technology. The outcomes can be beneficiary for both, the decision makers and policymakers in mitigating the difficulties encountered in Malaysian construction industry.

According to Sambasivan & Soon (2007) The Malaysia construction industry is a rapid developing country in South-East Asia but still not escaped from the problem of delays and in 2005, about 17.3% (out of 417 government contract projects in Malaysia) were considered sick (more than 3 month of delays or abandoned) In addition, improper planning at the initial stages of a project contractor manifests throughout the project and causes delays at various stages. Therefore, a project that is well planned can be well executed. Malaysian contractor often failed to come out with a practical and workable “planning” at the initial stage. This failure is interrelated with lack of systematic site management and inadequate contractor’s organisation experience towards the projects (Sambasivan & Soon, 2007).

Based on researched by Kamal, Haron, Ulang, and Baharum (2012) the Malaysian construction industry still suffers with many problems and being associated with low quality, low productivity, unskilled, project delays, poor maintenance, non-conducive and high accident rates on site. Understanding the weakness and strength of this industry can be an effective way to help the policymakers in selecting the best strategy in the promotion of the Malaysian construction industry (Dehdasht, Ferwati, Abidin, & Oyedeji, 2021). Current situation in Malaysia industry, work is coordinated during weekly or bi-weekly planning meeting (Garcia-Lopez & Fischer, 2014). However, any project with considerable cost overrun and schedule delay typically gets in trouble at its beginning, and project managers does not realize this problem until late in the project (De Marco & Narbaev, 2013). By applying drone technology, it can bring faster cycle and response time and sharing up-to-date information between project teams in a contractor organisation and can lead to minimizing errors, reduction in time delays and breaking the widespread rework cycle (Jaafar, Abdul Aziz, Ramayah, & Saad, 2007)

Technology advances in Malaysia recently have resulted in drone designs that are more reliable, less expensive, and easier to control (Tatum & Liu, 2017). Today, drones are frequently employed somewhere in the delivery of a construction project in Malaysia along the life-cycle from concept through completion. This increase in the use of drones makes sense as resulting aerial imagery has great value in documenting, communicating and recording current conditions with visual perspectives previously unavailable without large expense (Small, 2018). It is the government’s aim for the Malaysian construction industry to be a world class, innovative and knowledgeable solution provider (Kamal *et al.*, 2012). Technology readiness consist of four components: optimism, innovativeness, discomfort and insecurity (Jaafar *et al.*, 2007). Thus, the aim of this study to provide vital information about drone application in construction. Meanwhile, the research objectives are including (1) To

identify the usage of drone technology by contractor G7 in their project, (2) To study challenges faced by contractor G7 in implementing the drone technology in their project and lastly (3) To determine ways to overcome the challenges faced by contractor G7 in implementing drone technology in their project

The scope for this study will be limited to contractor G7 company that registered with Construction Industry Development Board (CIDB) and uses drone technology in their company's project. The location of this study covers in Klang Valley area (Selangor, Wilayah Persekutuan Kuala Lumpur). Reports by Department of statistic Malaysia (DOSM), Klang valley contributed RM12.7 billion towards the value of construction work done in quarter 1 2022 (DOSM). The data indicates that there was rapid development happened in the area. Thus, the researcher selected the area for process of getting respondent.

## 2. Literature Review

The Malaysian government has been pushing everyone including businesses, public agencies and even individuals to adopt technology (Jaafar *et al.*, 2007). The technology includes the drone itself as well as the control system, ground and satellite based equipment, communication links and operator which are required to operate the drones effectively and safely (Tatum & Liu, 2017). Despite so many applications of drone in construction, challenge of applying this technology in the construction jobsite that should be considered as well (Irizarry, Gheisari, & Walker, 2012).

### 2.1 Technology in Construction Industry

There are numbers of industries have evolved towards digitalization. Over the years, construction is one of the sectors that have implement new technologies. The rapid development of information technology become one of factor towards digitalization (Elghaish *et al.*, 2021). Thus, the increment of labour cost and the cheaper price to afford the technology has make advancement on new digitalization process and thus support the Industrial Revolution 4.0 (IR 4.0).

In construction industry, the application of recent digital technology such as drones are increasingly used, and become more popular. Drone is a flying autonomously robot controlled remotely through software-managed flight plans in its built-in systems, working directly in GPS and onboard sensors It can be used in many areas of construction process (Alsamarraie, Ghazali, Hatem, & Flaih, 2022). Drone can be used for task such as information gathering, surveying construction sites, monitoring construction process, progress tracking and monitor safety related aspect on site (Sawant, Ravikar, Bagdiya, & Bellary, 2021).

### 2.2 Drone Technology

Since drones have appropriate photography and video at high-definition or 4K resolutions, using drones for construction projects takes relatively little investment (Tatum & Liu, 2017). Furthermore, drone software assisting with efficient flight operations that makes many of these drones have become very straightforward to fly (Gheisari, Irizarry, & Walker, 2014). With these solutions, the availability of image and video-based information for construction project delivery has become easier. While video capability may be the most appealing feature of drones, there are also other uses for remote sensing in construction that may be investigated.

### 2.3 Implementation of Drone Technology in Construction Industry

Unmanned aerial vehicles (UAVs), sometimes known as drones have become commonplace among enthusiasts and professional communities around the world. Over the last decade, the usage of drones has become ubiquitous in the surveying and construction industries (Small, 2018). Although drones are relatively new additions to construction industry, they have long been utilized in other

industries, including the military, agriculture, disaster management, and area surveying (Jeelani & Gheisari, 2021). Drones are now regularly used in the delivery of construction projects at various stages starting from planning to project completion. Commercial drones are increasingly being used in construction, particularly for aerial photography, surveying, inspections, and safety and security monitoring on construction sites (Tatum & Liu, 2017). This growth in drone use makes sense because the resulting aerial photography is extremely useful for documenting, conveying, and capturing current conditions with visual views previously unattainable at low cost (Irizarry *et al.*, 2012). Example in the application of:

*(a) Building Surveys*

Almost every building inspection necessitates a view of the structure's roof in order to assess the building's technical condition and any flaws or defect. (Elghaish *et al.*, 2021) Climbing to the top is difficult in most cases, necessitating the use of scaffolding, ladders, or other auxiliary structures, which can be dangerous and time-consuming (Sawant *et al.*, 2021). In these cases, drone can help save time, money, and reduce health and safety problems when accessing sophisticated or difficult-to-reach portions of the building's top.

*(b) Topographic Mapping and Land Surveys*

When planning large-scale and complex construction projects, topographic maps are essential. Topographic maps can be used to reveal flaws in construction design that are inappropriate for the terrain. Topographic maps are useful for construction projects, but they are often costly and time consuming to develop (Tatum & Liu, 2017). Drones are extremely beneficial in these circumstances. Its ability to collect large amounts of data in a short amount of time results in significant cost savings, as well as lower project costs for these processes. Because of their capabilities, drones ensure project timeliness, budget, and accuracy

*(c) Construction Site Inspections*

Drone data may be obtained often by builders, allowing for speedy incorporation into projects and precise site development tracking with no lag time. This enables construction companies to better manage their time and resources while preventing potential problems and delays (Small, 2018). Construction site inspections using drones can be a useful tool for project teams. Drones can also be used for inspection purposes to ensure that project goals are met, and a pilot with prior experience can utilize the drone to spot any construction or technical concerns on the job site. Drones can save plenty of money in the event of rebuilding and plan adjustments (Elghaish *et al.*, 2021). Drones can also be safer because they minimize gaps or dangerous spots on the construction site when assessing damage. Drones can also be used to fly around a building site to see how well it matches the construction plan or model, besides can assist in the creation of detailed 3D models of new construction projects. In that case, Sawant *et al.* (2021) agreed that site inspections could be performed more frequently and efficiently, covering a larger region beside drones for construction site inspections could offer four main benefits which are greater data quality, less labor-intensive data, and increased data safety.

*(d) Remote Monitoring and Progress Report*

The ability of drone to fly in high altitude give the bigger view of the construction site and being the most significant benefits that drones can offer for its users (Jeelani & Gheisari, 2021). A continuous drone fly over a construction site can be a quick way to watch a project's progress, especially when clients can't visit the site in person. On top of that, the high resolution and HD-quality films enhance the view of project development at daily, weekly or monthly intervals. Sawant *et al.* (2021) stated drone survey will quickly and easily give an aerial overview, which will considerably assist project managers in a variety of ways.

## 2.4 Challenges of Drone Technology in Construction Industry

Drones can give several benefits but there is also challenge to implement this technology. Yahya, Shun, Yassin & Omar (2021) pointed out that some challenges including limited drone battery life, its vulnerability to damage and bad weather, drone complexity, security issues and safety problem.

### (a) Battery Life

Due to the limited battery power, one of the most significant issues facing drone applications in the construction industry is the short flying time. While charging, the drone will be in the air for 25 minutes (Yahya *et al.*, 2021). The battery life of the drone provides up to 13 minutes of continues flight. This should be increased to allow longer flight time (Irizarry *et al.*, 2012). The short flying time makes the drones capability declining. Thus, the activity that can be done using drone is limited.

### (b) Weather Aspect

Drones can distract construction workers, so expert operators are required to guide drone flights and the use of drones is limited by weather conditions (Macrina, Di Puglia Pugliese, Guerriero, & Laporte, 2020). Because of bad weather condition, the drones may experience violations such as component failure (Jeelani & Gheisari, 2021). The component failure will lead to unnecessary accidents that can occur and cause injury to the workers. Total irradiation, as well as sun angle and severe weather circumstances such as rain and strong winds, have a significant impact on multispectral picture collecting (Singhal, Bansod, & Mathew, 2018). The imagery captured from the drone may be blur and low in quality.

### (c) Security Issues

As far as weather aspect and battery life are concern, drone security issues also must to take into consideration. Security issues include the possibility that criminals will use drones for illicit purposes, putting victims' privacy at danger (Yahya *et al.*, 2021). For instance, the user could zoom in on a house window to take a snapshot and secretly record a video that disturbing the privacy of the house owner. In addition, drone often utilise GPS to navigate and a Wi-Fi network to communicate with the flight crew, and both of these networks are subject to security breaches (Jeelani & Gheisari, 2021).

### (d) Technical Knowledge

Technical knowledge is important aspect to be consider. The drone pilot needs to have knowledge about the drone before flying the drone to avoid accidents. controlled flight via GPS signals is deemed to be a high-risk activity (Golizadeh *et al.*, 2019). Without knowledge, it will be hard for the pilot to execute the drone operations.

### (e) Experience using drone

Drones required pilot that have experience with the application. It will ease in the process operation of the drone. The data capture by experience pilot may be different with un-experience pilot. In addition to the principal challenge with visual examination, the photo and video captured by the pilot can differ significantly depending on the pilot's knowledge and experience (Alsamarraie *et al.*, 2022).

### (f) Competency

The use of drone for a large-scale construction can be tricky as special skills is required. (Outay, Mengash, Adnan, & practice, 2020). Some drone operations in construction requires pilots to be properly trained and skilled to safely fly the drone in various types of spaces and conditions (e.g., indoor and outdoor sites, close to obstacles and structures, overactive sites) (Albeaino & Gheisari, 2021). It is because different site has different environment.

### 3. Research Methodology

Research Methodology explained method adopted by this research and mention every component to conduct the research including research process, data collection, data analysis, research instrument and conclusion. All the components are explained detailed.

#### 3.1 Research Process

This part explained the research element that developed and take place to give better understanding to the reader. It consists of 4 phase which are preliminary, information gathering, data collection and analysis, and the final phase is conclusion and recommendations.

Phase 1 are the beginning of this research. During phase 1, research title, problems statement, research question, research objective and research scopes are selected, identified and developed. It is the crucial phase that will be the foundation of this research towards the end.

Meanwhile, phase 2 all the data related to the research title are gathered. the information gathered through literature review. All the necessary information regarding the research objective were gathered through reading of journal, articles, thesis and internet sources. After the data have been gathered, draft of interview question was developed by referring to the literature review. The draft of interview question is reviewed by the following experts:

**Table 1: Research Instrument Reviewer**

Research Instrument Draft	Reviewed by	Time taken (Days)
Draft1	Drone Practitioner	4 days
Draft2	2 Academician	4 days
Draft3	Supervisor	3 days
Draft4	Supervisor	2 days

The research instrument been reviewed by 4 experts which are a drone practitioner, 2 academician and researcher's supervisor. The proses of developing research instrument takes approximately two weeks before final draft is ready. The process of reviewing research instrument help the researcher to get the best set of questions, easy to understand and able to answer the objectives of the study.

Next, phase 3 is the data collection and data analysis process. The data collected both through interviews, and the literature review method. The interview is the primary data while literature review was considered the secondary data. It is essential to undertake the data collection and analysis since it will determine whether the research objectives are achieved or not. The data are analyzed using thematic analysis. In order to analyze the data, all the data collected are organized. Discussion and explanation were provided understanding for the result of the research conducted.

The final phase is Phase 4. During this process, the researcher concluded all the data that been analyze. Recommendation also provided by the researcher for the purpose of future study.

#### 3.2 Method of Data Collection

Data collection is the method of gathering and assessing information on a systematic target for sustainable variables. It requires respondents to answer the related questions and the result is analysed by the researcher. This research used qualitative method that include both primary and secondary data.

##### (a) Primary Data

In this research, the researcher used qualitative method through interview where the respondents were interviewed in real-time interaction. The research instrument which is set of interview question were inspect by two academician, one drone practitioner, and supervisor before real interview take place. four draft of research instrument were developed to get the best set of question before going for the interview process. Qualitative method is best suited if research is poorly understood or if certain individuals need a thorough understanding. research conducted semi-structured interview for the

method of data collection. Semi-structure interview are those in-depth interviews where the respondents have to answer pre-set open-ended questions.

For the method of interview process, the computer-mediated interview was conducted. Computer-mediated interview is an online research method that use instant messaging or video conferencing. Google meet are used as platform of online computer-mediated interview for this research. Therefore, online interview (synchronous interview) allows the researcher to record the entire process of interview that help during analysis process. The interview also happened in real-time so that respondents from different locations reached easily.

#### *(b) Secondary Data*

According to Marican (2015), secondary data can be referred to as data that has been collected by other researchers. The data is still suitable and relevant to use to answer research questions or expanded to new information or formulations for current research. Literature review is a preliminary information gathering on scholarly sources of specific topics where it provides an overview of current knowledge, allowing research to identify relevant theories, methods, and gaps in the existing research. Literature review is also considered as an effective and well conducted review for research method where it creates a reference point for the development of knowledge and theory (Webster & Watson, 2002). The literature review is an important phase in the research process because it helps the researcher to create basis for research clarification and research problems.

### 3.3 Data Analysis

In this research, thematic analysis was used. each interview was audio recorded and transcribed. Transcription of data is the first step done after the interview. Thereafter, the transcribed data were read repeatedly to obtain in-depth understanding before categorizing the data. Next, the data categories were broken down according to the objectives in this study. After that, this category is further broken down into smaller sections that focus on the key points for each question asked towards respondents. This facilitates the analytic process and compares data from different respondents' responses. Furthermore, the data were tabulated for easier understanding. Researcher choose this type of data analysis approach because it is effective in making data analysis for an open-ended question as well as able to produce good results to help achieve the objectives of this research.

### 3.4 Research population and Sampling method

Population is the target group that the researcher intended to collect data. In the other hand, sample is specific group that the researcher makes data collection. Sample is acquired from specific population to reduce the cost and save time for the data collection.

#### *(a) Research Population*

Population can be described as set of elements consist that consist of person or object that have similar characteristic by the sampling as defined by the researcher (Bhandari, 2020). The size of population is bigger than the size of sample. For research purposes, target population is selected to make sure the data collected are genuine. In this research, the target population is focused on contractor Grade 7 (G7) in Klang Valley that registered with Construction Industry Development Board (CIDB). G7 grade allows the contractor to undertake unlimited project amounts. According to CIDB system, total number of 4707 grade G7 contractor that actively operating (CIDB, 2022).

#### *(b) Research Sample*

The Respondents consists of seven respondents that represent seven different G7 company in Klang Valley. There are so many G7 contractors that registered with CIDB. however, the number of G7 contractor that used drone in their project is limited. Due to that limitation, the researcher used snowball sampling method to gather the respondents. snowball sampling has become a popular means of

recruiting research participants when seeking access to hard-to-reach populations (Charlie Parker, 2019).

### 3.5 Research Instrument Development

#### *(a) Pilot Study*

Before the actual interview take place, pilot study was conducted. The respondents consist of industry people that are drone practitioner. Referring to Wiewiora (2011), pilot study aims to assist in interview process consistency and the relevance of the interview question. By doing the pilot study, any unnecessary question from the final draft of interview question was removed.

#### *(b) Interview Question (Semi Structured Interview)*

The interview questions were developed in four sections so that each of the research objectives will be achieved. The four sections on the interview question are as follow:

Section A: Respondent Profile

Section B: To identify the usage of drone technology by contractor G7 in theirs Project (Objective 1)

Section C: To study challenges faced by the contractor G7 in implementing the drone technology in their project. (Objective 2)

Section D: To determine ways to overcome the challenges faced by contractors G7 in implementing drone technology in their project. (Objective 3)

For section A, demographic question about the respondent were asked to gather the respondent background. The question asked in this section includes academic levels, position, years of job experience and years of experience using drone technology. This section indicates the respondent is suitable to be interviewed related to the drone technology. The open-ended query is designed in order that the respondents capable of offer responses of their very own words

#### *(c) Interview Protocol*

The interview protocol consists of procedures that need to be followed during the proses of the case study (Wiewiora, 2011). Prior to interview, a contact person from contractor G7 company that interviewed was approached by the researcher to inform them about the interview. Afterwards, an e-mail or message was sent to the contact person to arrange the date, time and online platform for the interview since the interview was held online. After that, the interview was conducted according to the agreed date, time and online platform.

## **4. Results and Discussion**

The data collected from seven different respondents from seven different G7 company that registered with CIDB as shown in Table 2. All the respondents all drone practitioners in construction projects and all the company based are focused in Klang Valley. The background of the respondent includes the positions, academic level, working experience, experience using drones, and company grade. It can verify the data collected by the researcher from the respondent is genuine and the respond from the respondent is effective for this research.



Table 3: Respondent's Background

Respondent	Position	Academic Level	Working Experience	Experience Using Drone	Company
R1	Contract Manager	Masters In Facility Management	20 Years	1-3 Years	A
R2	Senior Site Supervisor	Bachelor Degree in Construction Management	16 Years	4-5 Years	B
R3	Assistant Planner	Bachelor Degree Civil Engineering	4 Years	4-5 Years	C
R4	Senior Survey Manager	Diploma in Land Surveying	30 Years	4-5 Years	D
R5	Assistant Project Coordinator	Bachelor Degree in Quantity Surveyor	4 Years	1-3 Years	E
R6	Planning Engineer	Bachelor Degree in Construction Management	7 Years	4-5 Years	F
R7	Site Engineer	Bachelor Degree in Construction Management	4 Years	4-5 Years	G

#### 4.1 Results of Drone Technology Usage by Contractor G7 in Their Project

Each company that the respondent represent are using drone technology in every single stage of construction starting with inception phase, construction phase and completion phase. All the respondents also agree that drone technologies are mostly used during construction phase as shown in Table 3.

Table 3: The Usage of Drone Technology in Construction

Respondents	Reporting	Mapping	Progress monitoring	Survey	Presentation to Client
R1	/		/	/	/
R2	/			/	/
R3	/	/	/	/	/
R4	/	/	/	/	/
R5	/	/		/	/
R6	/		/		/
R7	/	/		/	/

From the table above, it shows that the most common drone usage is reporting task and presentation to client. All the respondents agreed that drones can benefits the most during both mention task. On the other hand, mapping and progress monitoring are the least using drone.

Table 4: Challenges Faced by Contractor G7 in Implementing Drone Technology

	Battery Life	Weather	Security issue	Safety problem	Technical knowledge	Experience using drone	Competency
R1	/	/			/	/	
R2	/			/	/	/	/
R3	/	/		/	/	/	/
R4	/	/	/	/	/	/	

R5	/	/	/	/	/
R6	/	/	/	/	/
R7	/	/	/	/	/

The challenges faced by the contractor G7 in implementing drone technology are shown in Table 4. From the table, technical knowledge is the most challenge aspect that the respondents responded. It follows with battery life and weather issue. On the other hand, the least challenges is security issue since the respondents are using drone in their own company property.

**Table 5: Opinion of Respondents Towards Government support**

Question: How the government can help to assist contractors in implementing drone technology?	
R1	The government can advertise the benefits of drones in construction, provide much more courses and seminar about drones and its application especially in construction industry
R2	Help to promote & encourage more drones courses & facilities
R3	Normally main contractor and client used the drone. The government can provide service centre that can repaired major problem of the drone that come from the oversea. It can save time because usually it takes 2 months for the drone to complete the major repair.
R4	The permit cost and duration of fly. Time frame of approvals from JUPEM and CAAM
R5	The government can ease the process of permit admission to fly drone. Currently it is quite hard to own the permit.
R6	Expose the benefits of using drone in construction. The government also can provide certificate for the drone pilot to say that they are competent to fly drone.
R7	By providing courses & funding

From the response of the respondents (refer Table 5), R1, R2, R3, R6 and R7 states that the government should help to promote the usage of drone technology in construction. By doing promotions, advertisement, drone courses and provide service centre, it will enhance the awareness about the drone in construction for all the construction players. Thus, the construction players are educated about the drone applications in construction. Through all the courses made, the construction players can be competent and ready to implement drone technology in their projects. This can solve the challenges face by contractors such as competency. On the other hands, R4 and R5 thinks the government can ease the process of drone permits admission. Currently, the permits need to apply from Department of Survey and Mapping Malaysia (JUPEM) and Civil Aviation Authority Malaysia (CAAM). The process takes time and it may affect the project construction phase. The respondents also highlighted to have a proper planning, be extra careful and do frequent service on the drone to avoid bad circumstances. By scheduling the drone operations and do service, the respective challenge can be resolve.

#### 4.2 Discussion

Based on the data collected and the literature review, the researcher could say that there are similarities among the objective of this study which are drone implementation, challenges and solution to resolve the particular challenges. All the respondents concrete the preceding researcher’s results about all objective mentioned in this research. Researcher identified there are relations between literature review and data received by researcher from the respondents.

Drone technology can be considered new technology advancement that has been started used in construction industry. The implementation of drone technology is widely use in military (Irizarry, 2012). However, in construction industry the usage of drone is still limited and need more in-depth study to allow wider use in the industry. New technology to be applied is closely related to the challenges ahead. Thus, the study of challenges and ways to resolve the challenges are necessary. In this research the researcher identified several challenges that mentioned by the respondents other than what has been identified by the past researchers. The respondents mention that drone technology can

be used not only during inception phase, but also during completion phase. The drone can help to gather data for the permit of project's Certificate of Completion and Compliance (CCC) and handover process. For the challenges, steel structure and site environment need to be considered to make sure the drone operation can be executed safely. The respondents mentioned that the steel structure is one of drones biggest enemy other than weather conditions. However, every problem needed a solution to resolve it. From the findings, the respondents suggest to have a proper planning before started drone operations and be extra careful during the operations. By having a proper planning, the users can determine the weather condition referred to the weather forecast, the site surrounding situations and can avoid accidents.

Drone technology is not hard to be implemented in the construction even it can be beneficial to the users in construction industry. Drone ease the process of progress reporting. However, the drone pilot needs to aware about the drone and needs to service the drone regularly. The challenges faced by drone user in construction industry were largely due to lack of technical knowledge. The personnel in charge of drone operation must have the knowledge before starts using it so it can be used to its full potential.

Drone can help through all construction life cycle which are inception phase, construction phase and completion phase but not all activity requires the drone help. Other than transportation field, there are a wide variety of ways drone technology can use and (Outay *et al.*, 2020). Responds from the respondents shows drone can be used in activity such as progress report, mapping, progress monitoring survey and presentation purposes. The results of data collection shows, drone frequently used for reporting progress of site to client, and survey task. Drone have also been used for site planning purposes that usually require extensive knowledge of on-site conditions, location, and surroundings (Albeaino & Gheisari, 2021). Drone can capture data (photo and video) from aerial view and various angles that makes the drone technology very practical towards process of progress reporting. The digital image gives a good capacity for monitoring and documenting the progression of the project and maintaining control of the facility's condition (Alsamarraie *et al.*, 2022). Meanwhile, the drone also can be used for the final presentation to the clients as been stated by the respondents. The presentation would be the photo or video of final product after the construction process is complete. Besides, photo from the drone that shows the project are completed can be inserted in the company profiles. The results show researcher had achieved the first objective that there are drone implementation among contractor G7 and can conclude that drone can be so useful in specific task of construction throughout construction life cycle.

Data collected on section D of the research instrument are about the challenges of implementing drone technology in construction projects. From the result, the main challenge of drone implementation in construction industry is technical knowledge. Implementing hands-on or practical training to ensure that pilots have the required proper skills to safely operate drone should be integrated by doing trainings provided by construction companies or the authorities (Albeaino & Gheisari, 2021). Despite all the challenges ask towards the respondents, technical knowledge is the most highlight by the respondents. Without technical knowledge, the uses of drone technology in construction are limited to certain function.

The least challenge issue is the security issue. The respondents are flying drones inside the construction site that makes there is no complain ever receive. There issue of trespassing of others property that makes the respondents think security issue is not the severer challenge the respondents face. However, the respondents express that site surrounding and signal interference become the significant challenges. Loss or interference of GPS signals drone within a building's interior or within the vicinity of densely populated buildings or high-rise buildings can lead to losing control of drone (Golizadeh *et al.*, 2019). The situation on site that full with steel structures causes the signal interference between the drone and the signal. The result shows the researcher has achieved objective 2 where the researcher concluded that there is various challenge to implement drone technology in construction industry.

The final objective of this research is to find solutions to overcome challenges faced by the contractor in implementing drone technology in construction industry. The researcher can conclude that all the parties including, government, company/worker, and personal needs to play its role to overcome the challenges. Easy permission of drone flying permits and take drone courses to enhance knowledge about drone are some of the actions that can be made to resolve the challenges faced. Drone operation also need to be done with proper planned and the drone pilot needs to be extra careful on the site surroundings. optimized and weighted site plan to improve hoisting operations' safety and efficiency (Albeaino & Gheisari, 2021). The result shows the researcher has achieved objective 3 where the researcher concluded that to resolve the challenges faced by the contractor G7, all parties including government, company/workers and personnel needs to play their roles and take necessary action to help the drone practitioners in construction to solve the challenge they were facing.

## 5. Conclusion

To allow new technology to be implemented, it need supports, research and adequate preparation. Every party should take risk and fully commit to make sure the implementation of new technology such as drone technology can succeed in construction industry. However, future research is needed to enhance the knowledge of drone application towards construction players. Thus, boost the numbers of drone users in construction industry.

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