

Drone Technology as A Modern Tool in Monitoring the Rural-Urban Development

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Abstract. The current practice of monitoring the rural-urban development in Malaysia is mainly based on conventional method that has limitations. This suggests that a modern technology, both hardware and software could be investigated to examine the application of drone technology and the appropriate systems namely Rural Grid System and Characteristics of Rural Malaysia System (CHARMs). An extensive literature review has been conducted to address the weaknesses of conventional method, the potential of drone technology in monitoring rural urban development, as well as the challenges of drone technology in term of limitation usage, pilot and auto pilot, and the rules and regulations. The finding shows that drone technology has its own strengths and weaknesses but its role in monitoring the rural urban development should be given priority. It is hoped that this paper can be a guideline for government agencies like local authorities, Department of Director General of Lands and Mines, and also private sector such as developer and investor who partake and apply modern monitoring through technological innovation notably in the land development process and site development progress.

Keyword: drone technology, land development, rural urban development, unmanned aerial vehicles.

1. Introduction

Land development refers to the preservation of natural resources, exploitation of resources or increased job opportunities in developed areas [23]. Parties involved in land development such as consultants need to think critically and creatively to solve arising issues during the land development process. Monitoring and controlling project progress are important parts of any land development process so that the project is being completed in a timely manner and the budget is under control [24].

Relatively speaking, technologies have been invented by researchers, technologists, and organizations for the purpose of reporting and gathering information to facilitate development monitoring work in the era of the Fourth Industrial Revolution (IR 4.0) [3]. Drone is an Unmanned Aerial Vehicles (UAVs), that is, one of the latest technologies invented to replace the conventional method for monitoring site development progress [1]. Monitoring the project progress using conventional method is time-consuming and the probability of error occurs is high [15]. Hence, a



modern tool like drone technology is the need of hour for replacing the conventional method that has limitations.

Therefore, this paper aims to discuss the application of drone technology on how efficient and how effective of this technology in monitoring the rural-urban development and what is the obstacles faced by this technology if any.

This paper is organized into eight sections, namely: (i) monitoring the rural land development, (ii) weaknesses of conventional method, (iii) modern monitoring using technological innovation, (iv) hardware: drone technology, (v) software: Rural Grid System and CHARMs, (vi) potential of drone technology, (vii) challenges of drone technology, and (viii) conclusion.

2. Monitoring the Rural Land Development

2.1. Monitoring

Monitoring described as an act of checking the progress compared to what was planned. Besides that, monitoring is an act of decision making to change outcomes in the future. Monitoring can also be considered as bringing the project back on schedule as planned for control purposes [6]. In addition, monitoring records the start and end dates of activities during the project [7]. In land development, monitoring is very important to run development projects more effectively, help in decision making for arising issues and easy to communicate the development progress to clients and investors [5; 21; 22]. Delay in detecting errors or issues on development sites can result in high total development cost spent on repairs whereby the normal problems that occur at the development site are caused by humans [14].

2.2. Rural Land Development

Rural land development in Malaysia was first emphasized in 1956 under the First Malaya Plan which emphasized the development of the rural economy sector at that time, the rural communities' economic status was very low compared to the urban communities. Figure 1 illustrated that in 1957, Tun Abdul Razak (Malaysia's Deputy Prime Minister at that time) introduced the First Rural Development Transformation aimed to develop the physical infrastructure and basic facilities for rural communities. This transformation led to the establishment of the Ministry of Rural Development Malaysia (KPLB) on November 17, 1959, which responsible for implementing the transformation by urbanized rural areas while minimizing poverty. In 1961, the Second Malaya Plan was formulated with a primary focus on rural development and the participation of the rural communities in the planning and implementation process [11].

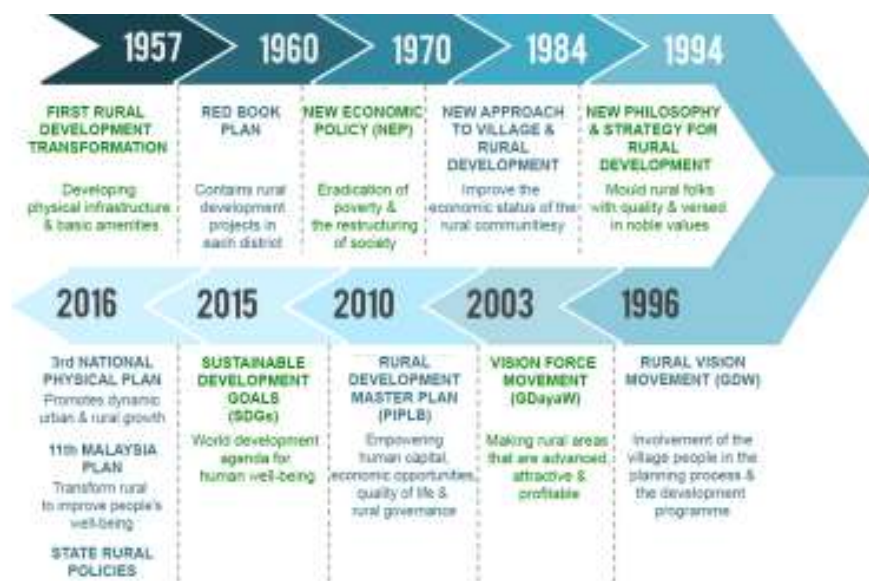


Figure 1. National policies related to rural development [16].

The current Eleventh Malaysia Plan (11th MP), the government introduce National Rural Physical Planning Policy 2030 or Dasar Perancangan Fizikal Negara Desa Negara (DPFDN2030) and Rural Development Policy 2030 or Dasar Pembangunan Luar Bandar (DPLB2030) to minimize the gaps between urban and rural areas. DPFDN2030 more to the rural development physical and spatial aspects while DPLB2030 more to the rural development social aspect. The direction of DPFDN2030 and DPLB2030 is in line with the ideas proposed by the United Nations (UN) in the Sustainable Development Goals 2030 (SDG2030) where rural communities also need to be prepared to face challenges in all aspects especially rapid technological advances of the Fourth Industrial Revolution (IR4.0) while maintaining environmental sustainability [11; 16].

3. Weaknesses of Conventional Method

There are two methods to monitor site development, either uses conventional methods or modern methods. The conventional monitoring method has several weaknesses which is less organized compared to the modern method. The conventional method that refers to a manual monitoring method is a method using the hands or physical strength to monitor site development. Normally, people will visit the development site and do survey work if needed. The update data will be recorded and picture will be snap using the camera as a prove. Even though the conventional method can use a helicopter or aircraft to take picture aerial view, but this will involve a high cost [20]. As a remedy to this problem, the modern technology can be seen as the best measures to monitor site development effectively and efficiently.

4. Modern Monitoring Using Technological Innovation

Fourth Industrial Revolution or known as IR4.0 was introduced in 2011 in Germany but has gained worldwide attention since 2016 when the World Economic Forum declared the world at the threshold of IR4.0. The main thrust IR4.0 is Artificial Intelligence (AI) involving the Internet of Things (IoT) that led developments of technology. Almost all aspects of human life today involve AI and IoT, which enables people to make great advances in supporting human life. AI and IoT are cyber-physical systems designed to study the environment and to connect the biological, physical and digital worlds to produce new technologies that impact various disciplines, economies and industries [18]. KPLB also use the current technology to monitor the rural development projects throughout Malaysia [2].

The modern monitoring use technological innovation to monitor site development. Technology is divided into two parts which are hardware and software.

5. Hardware

Hardware is a physical device, something that can be touched and viewed. For example, a computer monitor used to view text, or a mouse used to navigate a website [12].

5.1 Drone Technology

Drone is UAV also known as a flying robot is one of hardware technology. The drone was originally used for military purposed records as early as 1849, unmanned balloons filled with explosives have been used by the Austrians to invade Venice, Italy [13]. The creation of UAV for the first time occurred during World War I, when it was known as aerial torpedoes or now known as cruise missiles [10]. Nowadays, drones are widely used for other purposes such as search and rescue, surveillance, traffic monitoring and weather, fire suppression, agriculture, personal and shooting [13]. Figure 2 illustrates the components of drone technology. They are image transmitter, camera, gimbal, battery, speed controller, motor, propeller, flight controller and radio system are hided inside the body of drone.



Figure 2. Components of drone [9]

5.2 *Application of Drone Technology in Monitoring the Phases of Land Development*

In the application of drone technology, there are four phases involved in land development process. First phase is site study and site survey where drone technology provides geographic information such as shape of the terrain and the area around the site. Second phase is design phase. The land surveyor or drone pilot reviews and collects the site's photographic data capture by drone on site. The data then processed into selected software such as DroneDeploy and Pix4D to create highly accurate 3D computer models. These models allow developers to get accurate digital images of design concepts. This is the best and most cost-effective way for land developers to change their ideas and make changes before construction actually begins. Third phase is construction phase where drone is use to monitor development progress. Final phase is marketing and disposal. Drone is use to capture panoramic image from aerial view for marketing and disposal purposed [4].

6. Software

Software is a program, such as an operating system or a web browser, that can direct computer hardware to perform certain tasks. Unlike hardware, software has no physical form [24].

6.1 *Rural Grid System*

Rural Grid System is one of the software system that created in collaboration with Plan Malaysia (formerly known as Federal Department of Town and Country Planning Peninsular Malaysia) and the Department of Survey and Mapping Malaysia (JUPEM). Plan Malaysia has updated the rural data by using a square grid of 10,000 km x 10,000 km for each grid. The grid uses GIS spatial data obtained from JUPEM [16].

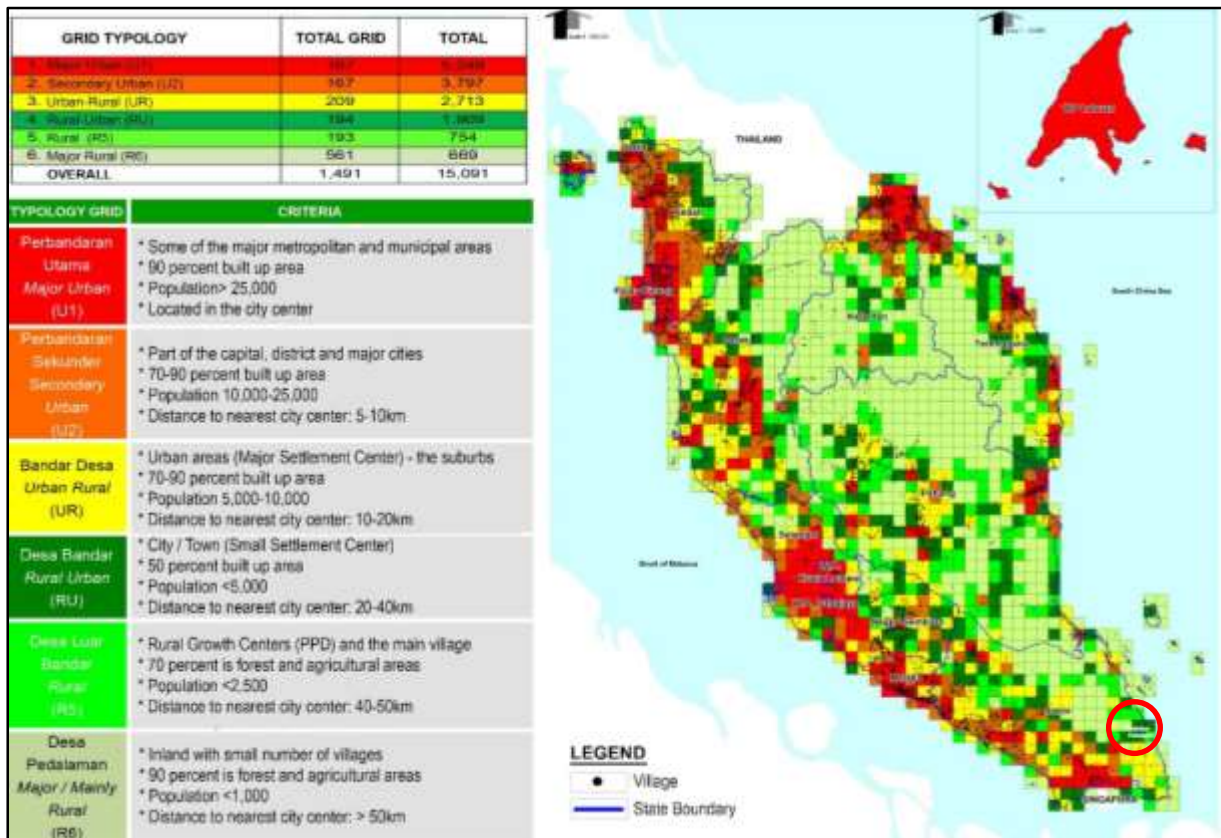


Figure 3. Typology Grid and Criteria Rural Grid System [16].

Based on Figure 3, Rural-Urban has 194 grid over 1,491 grid (equal to 13 percent). Bandar Penawar has 11.5km² total area located in Tanjung Surat (Mukim), Kota Tinggi (District), Johor (State) included in Rural-Urban.

6.2 Characteristics of Rural Malaysia System (CHARMs)

This system is created in collaboration with Plan Malaysia and Department of Survey and Mapping Malaysia or known as Jabatan Ukur dan Pemetaan Malaysia (JUPEM). Plan Malaysia developed this system using spatial data obtained from JUPEM specifically for DPF DN2030 which aimed to evaluate the level of village sustainability by identifying villages that have achieved sufficient development in terms of facilities and physical condition to improve the quality of life of the villagers. In addition, the system is designed to support in decision-making in resource allocation by identifying villages that need help in providing public facilities, infrastructure and utilities according to priority. The system also facilitates more efficient and transparent transfer of aids by the agencies involved in the planning and rural development to the target groups. Lastly, this system helps the government to monitor the implementation of DPF DN2030 based on the prescribed implementation indicators and make necessary improvements [16].



Figure 4. Location of Rural Growth Centre (PPD) for upgrade [16].

Figure 4 above shows that East-Coast Peninsular Malaysia has lack of facilities therefore, if the government need to upgrade the facilities, they need to give the priorities to the facilities development on East-Coast Peninsular Malaysia.

7. Potential of Drone Technology

Drone technology has more advantages compared to the conventional method as been discussed in the literature. First, it has the capability to improve accuracy in site monitoring by collecting large amounts of image or photographic data on-site in an instant. Second, the images of the site development can be seen in more detail compared to the 'Google Earth' or 'Google Street View' because drone usually flies 100 meters from the ground (depends on the obstacle on site) but both applications use the satellites located on the outer space to capture the image. Third, the drone technology is able to traverse high and rough terrain for data collection such as swamp, hill, dam, rural and forest. Last but not least, the drone technology also able to squeeze into tight spots [17]. Based on the abovementioned, drone technology has its own potential in upgrading and monitoring the urban rural development in Malaysia.

This is supported by our former Minister of Rural Development Malaysia, YB Datuk Seri Rina binti Mohd Harun. She stressed that the Ministry of Rural Development or known as Kementerian Pembangunan Luar Bandar (KPLB) will use drone technology in monitoring rural development since drone technology can provide more accurate and up-to-date information especially for the inaccessible rural area [2]. Nevertheless, modern technology also has pro and cons. Hence, the following section examine the challenges of drone technology in monitoring urban rural development.

8. Challenges of Drone Technology

Although drones have become a trend in monitoring recent development progress, the use of drones also poses some challenges or negative impacts on their use [18]. Therefore, there is a need to study the challenges faced by drones while monitoring the site development progress.

The result of an initial interview with informants based on their experience in operating drones for monitoring land development, the challenges of using drone technology in monitoring rural-urban land development can be classified into three categories which are shown in the table below:

Table 1. The challenges of using drone technology in monitoring rural-urban land development [5; 21; 22].

Classification	Challenge
Limitation usage	<ul style="list-style-type: none"> • Weather – drone cannot fly during rain and windy • Battery – Normally last around 30 minutes in flight • Payload – Total interface including camera, LiDAR and thermal sensor normally below than 20kg
Pilot and Autopilot	<ul style="list-style-type: none"> • Drone use Robot Operating System (ROS) also known as autopilot, so experienced and skillful pilot is needed to fly the drone especially during take-off and landing
Rule and Regulation	<ul style="list-style-type: none"> • Drone mapping is not accepted as legal mapping used for ownership • Civil Aviation Authority of Malaysia (CAAM) has set several rules for flying drones in Malaysia contained in the Civil Aviation Regulations 2016, Regulation 140 to 144 in section XVI regarding Unmanned Aircraft System

Table 1 has clearly discussed three categories that contribute into the challenges of drone technology. First is about the limitation, followed by pilot and autopilot, and finally, the rule and regulation that applied for drone technology. Under limitation, the challenges faced by drone technology included the weather, battery, and payload while for the category of pilot and autopilot, drone technology requires well-experienced pilot and having full skill in conducting the drone technology. On one hand, in rule and regulation category, specific terms have to be followed by all players as been provided by CAAM.

9. Conclusion

Drone technology is part of the current technology and should be used by all states authority in Malaysia. In conclusion, the paper discusses the potential of this modern technology in monitoring rural urban development by replacing the conventional method. The focus is on examining the progress and use of real resources as opposed to what the government or private sector has planned. Monitoring is required to assist both government and private parties in making a decision on the future outcome of projects. By doing this, such projects can be completed according to the planned work schedule through recording the monitoring date in order to see the progress in the development site.

The application of drone technology is supported by two appropriate systems that have been studied notably in updating the rural data through the Rural Grid System provided by PLAN Malaysia while another software called Characteristics of Rural Malaysia System (CHARMs) is designed by PLAN Malaysia in collaboration with JUPEM to support the decision-making in resource allocation by identifying villages that need help in providing public facilities, infrastructure and utilities.

In spite of the advantages of drone technology namely the capability to improve accuracy in site monitoring by collecting large amounts of image or photographic data on-site in an instant, the images of the site development can be seen in more detail compared to the 'Google Earth' or 'Google Street View', able to traverse high and rough terrain for data collection, and has the ability to squeeze into tight spots, but, it still has some limitations. Such limitations are restricted to the limitation usage, the skill of

pilot and autopilot, and specified rules and regulations. It is recommended that future research needs to be carry out to overcome these weaknesses in order to make drone technology relevant, effective and efficient to be used especially for the purpose of monitoring the land development process and site development progress.

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