

# EFFECTIVENESS OF AUTONOMOUS LANDING SYSTEM FOR UNMANNED AERIAL VEHICLES (UAV): A CASE STUDY AT MALAYSIAN MARITIME ENFORCEMENT AGENCY (MMEA)

<sup>1</sup>Aizat Khairi, <sup>2</sup>Shaiful Bakri Ismail, <sup>3</sup>Azizan Suhaimi

<sup>1</sup>Student Development Section, Universiti Kuala Lumpur, Malaysian Institute of Marine Engineering Technology Lumut, Perak, Malaysia

<sup>2</sup>Marine Electrical & Engineering Section, Universiti Kuala Lumpur, Malaysian Institute of Marine Engineering Technology Lumut, Perak, Malaysia

<sup>3</sup>Maritime Management Section, Universiti Kuala Lumpur, Malaysian Institute of Marine Engineering Technology Lumut, Perak, Malaysia

<sup>1</sup>aizat@unikl.edu.my, <sup>2</sup>shaifulbakri@unikl.edu.my, <sup>3</sup>azizansuhaimi97@gmail.com

## Abstract

This paper investigates the effectiveness of autonomous landing system of unmanned aerial vehicles (UAV) for Malaysian Maritime Enforcement Agency (MMEA). Nowadays, there is a growing need for flying drones or unmanned aerial vehicles (UAV) with diverse capabilities for both civilian and military applications. UAV's are utilized in carrying out a variety of operations including military tasks, search-and-rescue missions, reconnaissance, and load transportation. This study is using a qualitative approach by conducting an in-depth interview. Purposive sampling is identified by meeting with MMEA officers who are involved in UAV activity. The data is analyzed by the content analysis method based on the semi-structured question of the interview. As a result, there is a significant interest in the development of novel drones which can autonomously fly in different environments and locations and can perform various missions. In the past decade, the broad spectrum of applications of these drones has received most attention which led to the invention of various types of drones with different sizes and weights. This study concluded that the potential of using unmanned aerial vehicles (UAV's) for sea patrol purposes, benefits in terms of the maritime sector, and challenges of the existing UAV's with various navigation and control approaches.

*Keywords: Unmanned Aerial Vehicles (UAV), Malaysian Maritime Enforcement Agency (MMEA), benefits and challenges*

## I. Introduction

Geographically, many assets are required (boat) to patrol or to provide surveillance over the The Exclusive Economic Zone (EEZ). The agency requires something to operate at minimum costs, less manpower and less work to do patrolling and monitoring. Therefore, it appears to have the potential to cut down on running costs, employees, and time by operating Unmanned Aerial Vehicles (UAVs). This trial will therefore explore the role of MMEA in sea patrol and identify the benefits of UAVs.

following a detailed analysis of current research, the potential benefit can be obtained from this study. UAV and drone have the same unmanned functionality. Moreover, UAV is more advanced in its military function. This will reduce the security costs by using these UAVs. Besides that, the loss of life is reduced since the pilots operating the UAVs are stationed far away at the base. Most importantly, it saves time and provides faster information. UAVs can contribute to the security of the country. UAV usage can be an effective investment because money, resources and time can be saved.

The study is based on the territorial waters of Malaysia. (Repeated above). The study focuses on the functions, benefits, and challenges of using the UAV for maritime patrol.

## II. Literature Review

### A. Overview about UAVs

Drones always have some level of autonomy because they have no pilot and there is a difference between a automatic and autonomous systems. Automated systems are systems that have been pre-programmed to perform their own tasks, while autonomous systems can handle unforeseen situations by using pre-programmed rules to help make choices where automated systems don't have the freedom to choose this (Vergouw et al., 2016).

### ***B. The system of UAVs***

Pastor et al. (2006) stated drones as a complex system and involves six subcomponents working simultaneously to allow drones to perform good observations. Here are the subcomponents involved:

- Drone structure - It is a platform without a stable, efficient pilot, lightweight and simple.
- Computer flight - A computer system that is central to drones and designed to collect aerodynamic data to automatically direct drone flights throughout a flight plan through several surface controls on the drone framework using a set of sensors consisting of accelerometer, pressure sensors, gyros, GPS, meters magnets and so on.
- Load - It is a set of sensors that directly processes part of the data collected or transports it to the base station for further analysis and consists of infrared to camera sensors, thermal sensors and so on.
- Base station - The computer systems on the ground and designed to monitor the development of the tasks being performed while at the same time handling the drones and the load they carry together.
- Communication tool - A combination of several connected devices to keep the drones and base stations in contact consisting of radio modems, microwave connections, satellites and more.

### ***C. Regulation of the use of drones in Malaysia***

The Department of Civil Aviation Malaysia has set several rules for flying drones in the Civil Aviation Regulations 2016 as set out in regulations 140 to 144 in section XVI regarding driverless aircraft systems (Peraturan-Peraturan Penerbangan Awam 2016, 2016). The following rules are set:

- i. A drone cannot be flown more than 400 feet from the ground unless authorized by the Director General [Rule 140 (1)]
- ii. Drones may not carry any packages for delivery purposes [Regulation 140 (3)]
- iii. Any on-air activity involving the use of drones shall require the approval of the Director General [Regulation 141 (1)]
- iv. Drones must be safely flown to whoever controls the drone [Rule 142 (1)]
- v. Drones should be controlled to avoid any violations [Rule 142 (2)]
- vi. Drones must be flown within 150 meters of an area of over 1,000 people [Rule 143 (1) (d)]
- vii. Drones flying at 50 meters from the area where the object is located are not permitted [Rule 143 (1) (e)]
- viii. A flying drone in a human area must be within 50 meters [Rule 143 (1) (f)]
- viii. Drones wishing to land or take off in areas where humans must be located within 30 meters [Rule 143 (1) (g)]

- ix. Only drones weighing under 20 pounds may be flown without the approval of the Director General [Rule 144 (1)]

### **III. Methodology**

#### ***A. Research Design***

In the qualitative method, interviews are typically used as a method for collecting primary data. A researcher is required to prepare the questions in various ways as they must be a tailor to the field of research to make sure the scope and purpose of the research are achieved. Besides that, look at websites and make it a qualitative method of reading newspapers, articles, and others. For this research, the interviews involved the MMEA officer.

The structure of the interview questions is divided into four sections which are A, B, C, and D the type of questions is semi-structured interviews. The details of sections as below:

1. Section A – cover on demographics and other general information which includes name, gender, unit, and respondent work experience.
2. Section B – This section focused on the general function of the UAVs on implementing it in Malaysia.
3. Section C – benefits of using UAVs for sea patrol related to achieving the objectives research.
4. Section D – focused on the challenges of using UAVs for sea patrol related to achieving the objectives research.

#### ***B. The Interview Method***

One of the key methods of data collection in survey research is the interview process. In this semi-structured interview, the interviewer asks not only some formal questions planned before the interview, but also helps the researchers to analyse the answers provided by the interviewees in more detail and to ask questions. In addition to structured questions, open questions are very helpful for the interviewer to obtain more information about the goals, particularly in the study. It offers a chance to determine new ways of seeing and understanding the subject.

Although in a semi-structure question the questioner may ask any question, the question must be related to the research goals of the case study. The interviewer can, in other words, ask other questions and have the same purpose. In addition, the question can depend about the respondents.

#### ***C. Sampling***

Sampling is the selection process for researchers of several topics from the population. Purposive sampling is the method by which a group of subjects have certain characteristics and are chosen as participants. The goal or intent of the study is focused on it. Only those elements are chosen from the population that are primarily designed to the same UAV analysis.

The main purpose of a purposive sampling method is to concentrate on certain features of a population that can best answer research questions during interviews. The sample studied does not represent the population

but is a qualitative or mixed method research design for the researcher. This is therefore not regarded as a weakness.

#### ***D. Content Analysis***

Content analysis is a research method for the identification of certain words or ideas in texts or collections of texts. Researchers assess and examine the nature of these words and phrases, their meanings and their relations, and then draw conclusions on the texts, the writers and the audience and even the society and time in which they participate.

### **IV. Result and Discussion**

#### ***A. Function of UAVs***

UAVs are used in a wide variety of civil and military applications, decreasing the risks inherent in conventional manned aircraft surveillance, and providing improved performance without the constraints imposed by a human pilot. When we talk about UAV's, the Intelligence, Surveillance and Reconnaissance (ISR) is all about that. The Malaysian Maritime Enforcement Agency (MMEA or APMM in Malay) released further specifics of its Offshore Patrol Vessel (OPV) programmed, which was first announced in the 2016 budget by the Prime Minister. DS Najib Razak said during the presentation that the government would allocate RM864 million to the MMEA for OPV procurement. As for the UAV on the OPV, Ahmad Puzi said they could specify the same as being used on the New Generation Patrol Craft (NGPC) Thales Fulmar to minimize maintenance and training costs, they will also consider other items (Marhalim Abas, 2016).

Under the Maritime Security Initiative (MSI) programmed, the 12 surveillance drones worth almost RM80mil to be used by the country's navy and army were funded by the United States. Based on 'Star Online' "The first batch of six ScanEagle UAVs is expected to arrive in mid-November" It also said that apart from the Malaysian Armed Forces, other enforcement agencies would also benefit from enhanced maritime surveillance and sharing of information. The ScanEagle UAV will help Malaysia in maritime patrolling" the ministry said in a statement.

#### ***B. Benefits of UAV's***

In this universe money is important. Without money how the MMEA will do its job because of less assets, if the money allocated to the MMEA is small, then how can the solution be done with a small amount of money but requires wide area monitoring because the navy law enforcement duty cannot be changed by 24 hours and 7 days monitoring. To do this we need to have something that we can run at lower cost. UAVs are the right way to manage MMEA for now. It is related to the variation factors such as cost of repair, usage of the workforce, consumption of oil and differential in purchasing price. First factor is about maintenance costs, each time before heading out to sea to carry out sea patrol operations, MMEA must carry out a comprehensive inspection and maintenance to ensure no damage occurs during the activity.

UAVs can allow quick and versatile access to challenging locations and can be captured by a UAV easily, cost-effectively, and safely. UAV's eliminate potential risks and allow quick and safe inspections. This reduces the need for staff to physically enter extreme conditions, since factors such as height, water, tides, temperature, pollution, and enemies can lead to loss of life (Y. Zeng and R. Zhang, 2017). In addition, UAV's allow professionals to easily gather aerial data in areas that are technologically impossible. UAVs, such as

radiation detectors, high-voltage control lines, and other actions that may lead to injury or death, are less dangerous and easier to use for harsh conditions. MMEA no need to send suicide squad, especially during reconnaissance, this UAV can contribute or substitute as the soldier.

The same is true of the MMEA, time which is also necessary for their activity, especially in border surveillance. It means that these UAVs are great in terms of man's low use and strong in Malaysia in terms of time with variable weather conditions. Y. Zeng and R. Zhang (2017) also agrees with UAV 's fast and time-saving approach by reducing the time required to erect ladders, access towers, rotational stages, aerial lifts and other related equipment. Also, we do not have to hire or pick up heavy equipment and big pick-up trucks for each inspection. Assuming the job takes less time, that we will test more property in another day.

UAV inspection can be carried out by remote pilots on request in a very short time. UAV's can be used in normal and emergency situations, as it takes just minutes to start a UAV. In addition, UAV's are fast and no need to plan for deployment or launch for a long time, it only takes about 5-20 minutes. As such, Intelligence, Surveillance and Reconnaissance (ISR), Sea Patrol, or Search and Rescue (SAR) can quickly ask for guidance and for less than an hour collect information. That UAV is as good as a trip to rescue. When we are talking about searching and rescue speed is an important part of a rescue mission, the UAV is the perfect fit for that. UAVs are also suitable for use in surveys and border monitoring operations because if we use a ship it may be a long way to get to a long and time-consuming location but with UAVs we can track crime movements or foreigners quickly (Chiang, Li, Shang, & Urban, 2019).

### ***C. Challenges of UAV's***

For every country, security is a very delicate problem. Is it clear to hire maintenance entities due to the introduction of the latest technologies and the lack of our skills and experience as the UAV is used only by the MMEA, while maintenance is carried out by outside persons? The same applies to UAV command and control vulnerabilities. You must think of the operating and servicing community as a good reason for using a UAV in the MMEA. That is because it is sometimes obsolete or forget how to fix it and use it when adopting a technology. This means that the next generation's successor to share UAV knowledge is less emphasized and, when this happens, the expertise in using UAV is lost. The working and managing society must therefore be sharpened and polished.

And unable detect and avoid other aircraft and objects in a manner comparable to a manned aircraft, UAV has its weakness. Apart from that, UAV provides only information rather than actions. UAV provides data input to the monitoring vessel when considering the idea of activity itself. Since the UAV can track only, UAV will immediately report to the patrol officer for further action in the case of any concern at sea.

## **V. Conclusion**

The UAVs are responsible for preserving the sovereignty and protection of the waters of the property. UAV provides more benefits than patrol vessels, such as wider scope of tracking, less error and quicker completion of the job. Some of the main challenges to use UAVs for the patrol of the sea is the use of unused aircraft for non-selective airspace, including breach protection, obsolete operational and maintenance culture. It would produce UAV accidents due to the restricted usage of UAVs. In conclusion, it is hoped that the key advantages and challenges of this work would help pave the way for the potential development of UAV applications by the MMEA. Because of its ability to begin a new era of modern technology, UAV seems to be able to enter the world market, it has provided a puzzle to MMEA that this magnificent UAV tool and computer will be used in future for weapons instead of patrolling the EEZ and Malaysian borders. As we know, the UAV continues to change with time. UAV in the new technologies will thus be changed according to the climate and surroundings. Once this transition and progress is made, the MMEA will provide training

and deliver the modified UAV from time to time.

## VI. Acknowledgment

We would like to express our thanks to Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology (UniKL MIMET) for the support and encouragement. Not forgotten to Malaysian Maritime Enforcement Agency (MMEA) who are willing to be provide a good cooperation in this study.

## References

- [1] Becerra, V. M. (2019). Autonomous control of unmanned aerial vehicles. *Electronics (Switzerland)*, 8(4). <https://doi.org/10.3390/electronics8040452>
- [2] Cited, R., & Gatos, L. (2018). *Thum tuullullittur*. 2.
- [3] Dittrich, J. S., & Johnson, E. N. (2002). *MULTI-SENSOR NAVIGATION SYSTEM FOR AN AUTONOMOUS HELICOPTER*. 1–9.
- [4] Elliott, J. (2006). Inter-particle forces in dry powders. *Chemical Engineering*, 19(3), 371–380.
- [5] Hildmann, H. (2019). *Review: Using Unmanned Aerial Vehicles ( UAVs ) as Mobile Sensing Platforms ( MSPs ) for Disaster Response , Civil Security and Public Safety*. (1), 13–19. <https://doi.org/10.3390/drones3030059>
- [6] Macés-Hernández, J. A., Defaÿ, F., & Chauffaut, C. (2018). Autonomous landing of an UAV on a moving platform using model predictive control. *2017 Asian Control Conference, ASCC 2017, 2018-Janua*, 2298–2303. <https://doi.org/10.1109/ASCC.2017.8287533>
- [7] MMEA OPV Programme. (2016, April 25). MMEA OPV Programme. Retrieved from <https://www.malaysiandefence.com/mmea-opv-programme/>
- [8] Singhal, Gaurav & Bansod, Babankumar & Mathew, Lini. (2018). Unmanned Aerial Vehicle Classification, Applications and Challenges: A Review. 10.20944/preprints201811.0601.v1.
- [9] Y. Zeng and R. Zhang, "Energy-Efficient UAV Communication With Trajectory Optimization," in *IEEE Transactions on Wireless Communications*, vol. 16, no. 6, pp. 3747-3760, June 2017, doi: 10.1109/TWC.2017.2688328.
- [10] Chiang, W., Li, Y., Shang, J., & Urban, T. L. (2019). Impact of drone delivery on sustainability and cost: Realizing the UAV potential through vehicle routing optimization. *Applied Energy*, 242, 1164-1175. doi:10.1016/j.apenergy.2019.03.117

- [11] Mozaffari, M., Saad, W., Bennis, M., Nam, Y., & Debbah, M. (2019). A Tutorial on UAVs for Wireless Networks: Applications, Challenges, and Open Problems. *IEEE Communications Surveys & Tutorials*, 21(3), 2334-2360. doi:10.1109/comst.2019.2902862
- [12] Shakhathreh, H., Sawalmeh, A. H., Al-Fuqaha, A., Dou, Z., Almaita, E., Khalil, I., . . . Guizani, M. (2019). Unmanned Aerial Vehicles (UAVs): A Survey on Civil Applications and Key Research Challenges. *IEEE Access*, 7, 48572-48634. doi:10.1109/access.2019.2909530