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The Use of Unmanned Aerial Vehicles in Thailand for Transportation and Air Traffic Control in the Future

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Abstract

The objective of this qualitative research is to study Thailand's use of Unmanned Aerial Vehicles for transportation and air traffic control in the future. In-depth interviews were performed on a group of 21 respondents consisting of Thai air traffic controllers, air traffic control unit supervisors, drone law experts, and experts or those experienced in using drones for transportation. The data collected from the interviews were analyzed with the content analysis method. It was found that 1) the current status of the uses of Unmanned Aerial Vehicles in Thailand are for military operations, aerial patrol for resource conservation organizations, high-angle photography, and agricultural uses, but presently not for transportation. 2) The use of Unmanned Aerial Vehicles for air transport in the future is a new type of transportation called Urban Air Mobility (UAM), which is a new aerial transport system that flies people and products around cities and suburban areas at the lowest altitude. 3) Thailand's use of Unmanned Aerial Vehicles for air traffic control in the future raises the challenge to implement UAM in the future, seeking cooperation to build capabilities in four key areas: regulations, technology, infrastructure development, and personnel development.

Keywords: Unmanned Aerial Vehicles (UAV), Urban Air Mobility (UAM), Thailand's Air Traffic Control

Background

The aviation industry is a key industry for people to send goods to various places within a short period of time (Eiampan, 2019; Puncreobutr & Saowaros 2016). With the increasing demand for the transportation of passengers and products by air, there is a need to improve the aviation industry's transportation efficiency (Panprasit and Somsuk, 2016; Puncreobutr et. al., 2017).

Unmanned Aerial Vehicles (UAVs) are a course of action for the development of aircrafts to increase the efficiency of aerial transportation (Puncreobutr, 2016). UAVs have been used since the beginning of the 1900s in the aviation industry and the military for experimental aircraft testing and as aerial targets in military training (Taylor & Munson, 1977).

With continuous development, UAVs have been modified rapidly with improvements such as flight range capabilities and absolute ceilings. The 4 improved UAV flight ranges are: UAV Close Range (UAV-CR), a flight range of no less than 50 km, UAV Short Range (UAV-SR), a flight range of no less than 300 km, UAV Medium Range (UAV-MR), a flight range of no less than 600 km, and UAV Long Range (UAV-LR), a flight range of more than 3,000 km. The 5 improved absolute ceilings are: low ceiling, an absolute ceiling of less than 2,000 ft., moderate ceiling, an absolute ceiling of less than 45,000 ft., moderate ceiling with long flight range, an absolute ceiling of less than 45,000 ft. with more than 20 flight hours, high ceiling, an absolute ceiling higher than 45,000 ft., and high ceiling with long flight range, an absolute ceiling higher than 45,000 ft. with more than 24 flight hours (Elias, 2020).

With the increased capabilities of UAVs, there is a larger demand for them in the commercial sector. Several countries have been conducting research and testing with commercial aircraft and drone manufacturers, logistic companies, and travel operators to develop concept aircrafts as well as perform flight tests for transportation (Matese et al., 2015; Barlow et al., 2019).

In Thailand, there is a usage of UAVs to a certain extent, but not quite so much. Nevertheless, Thailand has promulgated rules and relegations to control the use of drones in compliance with the International Aviation Organization (1984). However, in the case that the trend of UAVs or drones use increases, there might be some development of UAVs for transportation.

Furthermore, St. Theresa International College is offering studies in the Air Traffic Control program. In order to manage the program so that it stays current with future advances in the aviation field, the researcher recommends conducting a study on the use of UAVs for transportation and air traffic control in Thailand in the future. The instructors, curriculum committee, and the college administrators can benefit from this study by using its findings to develop course materials or improve the curriculum to respond to the country's needs, and

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to provide positive contributions to the field of air traffic control, and the domestic as well as international aviation industry.

Research Objectives

1. To study the current status of the uses of Unmanned Aerial Vehicles in Thailand
2. To study the use of Unmanned Aerial Vehicles for transportation in the future
3. To study the use of Unmanned Aerial Vehicles for air traffic control in the future

Research Methodology

This qualitative research conducted in-depth interviews with 21 respondents consisting of 4 Thai air traffic controllers, 6 air traffic control unit supervisors, 5 drone law experts, and 6 experts or people experienced with the use of drones for transportation. The purposive sampling technique was used to select key informants, where each respondent must have at least 5 years of work experience. Data collection took place between September to December 2019. The data collected from interviews was triangulated and analyzed with the content analysis method, then the findings were summarized.

Research Results

1. The Current Status of The Uses of Unmanned Aerial Vehicles in Thailand

The in-depth interview results showed that Thailand has been using UAVs since 1988. The type of UAV was an RPV (Remotely Pilot Vehicle), model R4D SkyEye manufactured by BAE. The main task was to inspect and take photographs while accompanying the Royal Thai Air Force reconnaissance aircrafts.

The majority of UAVs used in Thailand are for military purposes, for example, weaponized Combat UAVs (CUAVs) are used for attack missions or target identification. The Royal Thai Army uses Tactical UAVs for multipurpose missions. The Royal Thai Navy uses Vertical Takeoff and Landing Tactical UAVs that can launch and land vertically on ship decks for reconnaissance missions.

Besides the military, government agencies use UAVs for patrol flights over specific areas for forest and marine resource conservation initiatives, patrol flights over precarious or dangerous grounds, as well as for traffic monitoring, or for search and rescue during disasters.

The private sector uses UAVs primarily for mass communications such as high-angle photography, live coverage of ceremonies, sports events, or concerts. For the performing arts, UAVs are used in TV series and movie productions. In agriculture, they are used for aerial applications of fertilizers and chemicals.

As an overview, the current use of UAVs in Thailand by the military are for aerial patrol or aerial operations over dangerous grounds. Besides military uses, government agencies use UAVs for aerial patrol for resource conservation and search and rescue missions. As for the private sector, UAVs are mainly used for high-angle photography and for agricultural purposes. At present, UAVs are not being used for transportation.

2. The Use of Unmanned Aerial Vehicles for Transportation in the Future

The in-depth interview results showed that the use of drones for transportation is considered a new type of aerial transportation called Urban Air Mobility (UAM). Specifically, UAM provides aerial transport for people and products around the city and suburban areas at the lowest altitude.

UAM is an important step in transforming transportation in the future. Traveling by air will be very convenient, safe, and reasonably priced, primarily using the Electric Vertical Take-off and Landing Aircrafts: eVTOL). This type of aircraft can either be flown by a pilot, controlled remotely by a pilot, or fly unmanned with automatic systems through vertiplaces.

The key objectives of using UAM for transportation are to make traveling around the city and the suburbs more convenient, solve traffic congestion problems in big cities, reduce travel times, costs, and pollution. The details are as follows:

1. UAM can solve traffic congestion problems in large metropolitan areas and allow for fast transportation. Studies in China, the United States of America, and Japan have found that traveling with eVTOL, as compared to traveling by automobiles, reduces travel time by 70-80% depending on flight duration, speed, distance, altitude, and total weight. Thus, when more people travel with eVTOL, there will be less cars, which will reduce and subsequently eliminate traffic congestion.
2. UAM can save travel costs. Studies from several countries on the current costs of traveling with UAM found that it is more expensive than traveling by car, but cheaper than traveling on a helicopter or a plane. Therefore, if eVTOL is improved to be more efficient, the cost of traveling by eVTOL is predicted to be only slightly higher than the cost of traveling by automobiles. Moreover, when other costs of owning an automobile such as expressway tolls, parking fees, and depreciation costs were factored into the cost comparison, the costs of the two modes of transport will be very similar, but traveling with eVTOL will be evidently faster.
3. UAM can reduce noise pollution and the pollution created from the combustion of fossils or petroleum-based fuel. Studies have found that the noise pollution level generated by eVTOL, depending on the

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manufacturer, is almost the same or less than the level generated by an automobile. However, eVTOL does not emit pollution from combustible fossil or petroleum-based fuel.

Regarding the possibilities of implementing UAM in foreign countries, it was found that many countries have set targets to develop and use UAM for commercial purposes from 2023 onwards. For example, Dubai aims to use UAM to transport passengers by 2023, the United States aims to use UAM to transport passengers in Los Angeles by 2024, France aims to use UAM to transport passengers and products in time for the 2024 Olympics, Japan aims to transport passengers and products on UAM in time for the 2025 World Expo in Osaka, and Singapore is set to perform UAM test flights by 2023.

For the feasibility of implementing UAM in Thailand, the government has issued a policy to agencies involved in air traffic control such as the Aeronautical Radio of Thailand Ltd., The Civil Aviation Authority of Thailand, Defence Technology Institute, Air Operations Control Command, Geo-Informatics and Space Technology Development Agency, and the Senate Communications and Telecommunications Commission to begin conducting UAM researches. These organizations have collaborated with UAM developers and eVTOL manufacturers in various countries to study and adapt for use in Thailand. It is forecasted that Thailand's use of UAM could be for both commercial transportation and to make Thailand the UAM research and development center for the ASEAN region with Singapore's Seletar Aerospace Park as the model.

3. The Use of Unmanned Aerial Vehicles for Air Traffic Control in the Future

The in-depth interview results showed that the experts and those involved agreed that the challenges in air traffic control for UAM in Thailand's future include 4 key aspects: rules and regulations, technology, infrastructure development, and personnel development. The details are as follows:

1. Rules and regulations

It is crucial to take consumer safety into consideration when implementing UAM for commercial purposes. Therefore, it is necessary to properly establish rules and regulations that are suitable for consumers and operators of UAM. These rules and regulations should not put a burden on the operators, especially the Thai start-up companies, and must be suitable for use in Thailand. For instance, to review import duties on parts and equipment used for the development of unmanned aircraft, unmanned aircraft standards, and the standards for equipment involved in the development of unmanned aircraft such as airframe, propulsion system, control system, launch and recovery system, navigation and guidance system, ground control system, data link and storage system, and self-protection system.

In addition, safety standards need to be set for consumers. These standards include certification, licensing, and standard audits of eVTOL, eVTOL controllers/launchers or pilots, vertiplaces, pollution control and prevention, air traffic control, and the Unmanned Aircraft System Traffic Management (UTM) standards.

The rules and regulations need to be clear and urgently defined. For example, the unmanned aircraft standard setting and certification can follow the standards from the International Organization for Standards (ISO), ISO-Technical Committee/20 Unmanned Aerial Systems (ISO TC/20 UAS), or the American National Standard Institute (ANSI) under the ANSI-Unmanned Aircraft Systems Standardization Collaborative (ANSI-UASSC). The promulgation of the rules and regulations must take into account the hardware standards that will follow the principles of airworthiness, and software standards of cyber security.

2. Technology

UAM is an evolving technology, hence its implementation must prioritize a very high level of safety. Safety factors to consider include the take-off and landing system, traveling, stationary and moving object detection system to prevent eVTOL collisions with each other or with other objects, accident prevention system inflight or during the loss of control, battery power system, short circuit protection system, and communication system.

In implementing technology for commercial purposes, it is crucial to consider the technology transfer of hardware and software. Furthermore, data control and storage should be kept at a central domestic location in order to be competitive in the future implementation of international UAM systems.

3. UAM infrastructure development

The use of eVTOL is a new phenomenon. Hence there is an urgent need to accelerate the development of new infrastructures to support it, such as an Unmanned Aircraft System Traffic Management (UTM) to set fly zones, infrastructures, and give operating instructions for the safety and efficiencies of unmanned flights.Presently, there is a special administrative flight test area or a Sandbox to support the generation of new innovations like the UAV Sandbox at the Wangchan Valley in the Eastern Economic Corridor of Innovation of Thailand.

Additionally, there is a need to develop other UAM infrastructures, for example, the infrastructures for communications, vertiplaces, maintenance hangars, passenger terminals, cargo terminals and warehouses, and

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charging stations. There is also a need to accelerate the improvement of the current aviation infrastructures such as the development of integrated flight control software and flight planning to support as well as facilitate the new ones.

4. Personnel development

The key aspects of UAM personnel development should cover the legalization/licensing of the UAM professions in manufacturing, services, and unmanned flight control and/or jobs like air traffic controllers, eVTOL design, research and development, and maintenance personnel. Furthermore, personnel that manage UAM should be integrated into the supply chain. Personnel development also involves the production of pilots for eVTOL manned flights, and controllers and launchers for unmanned flight operations or autopilot flights.

Job qualifications such as educational/knowledge and ability requirements should be defined to set clear standards for these professions. In order to achieve international recognition, personnel development should include curriculum design for this field of study. Training programs conducted by relevant agencies should be controlled by an authority to ensure compliance to the set standards.

Consequently, after these professions are legalized under Thai law, the personnel who underwent the development program must properly register with the authorities, for example being certified as eVTOL controllers/ launchers, or register a Remote Pilot License.

Summary of Research Results

The results summarized as follows:

1. The Current Status of The Uses of Unmanned Aerial Vehicles in Thailand

UAVs are being used in both the government and the private sectors. The government uses them in the military and in resource conservation agencies. The private sector uses UAVs for mass communications and agricultural purposes. However, at present, they are not being used for transportation.

For military uses, the Royal Thai Air Force, Royal Thai Army, and the Royal Thai Navy use UAVs as Combat UAV, Tactical UAV, and Vertical take-off and Landing UAV. While resource conservation agencies use them for aerial patrol over hazardous grounds, traffic monitoring, and search and rescue missions during disasters.

The private sector's mass communications industry uses UAVs mainly for live broadcasting and high-angle photography. In agriculture, they are used for aerial applications of fertilizers and chemicals.

2. The Use of Unmanned Aerial Vehicles for Transportation in the Future

In foreign countries, UAVs play a role as the new type of aerial transportation called Urban Air Mobility (UAM), an aerial transport system for people and products around the city and suburban areas at the lowest altitude.

UAM uses Electrical Take-off and Landing Aircrafts (eVTOL) that can either be flown by a pilot, remotely controlled by a pilot, or unmanned with an autopilot system. eVTOL stations are small and located inside the cities. The objectives of UAM are to bring convenience to inner city and suburban travels and solve inner city traffic congestion problems, resulting in shorter traveling time, cost savings, and reduced pollution.

It is predicted that many foreign countries will be able to implement UAM for transporting people and products in the near future. For example, Dubai and the United States will be able to implement it in 2023, while France and Japan in 2024-2025. Moreover, many countries are already doing experimental or test flights, Singapore is predicted to run UAM tests in 2023.

3. The Use of Unmanned Aerial Vehicles for Air Traffic Control in the Future

The Thai government has commissioned agencies involved in air traffic control to study the feasibility of implementing UAM in Thailand. The results forecasted that Thailand's use of UAM could be for both commercial transportation and to make Thailand the UAM research and development center for the ASEAN region with Singapore's Seletar Aerospace Park as the model.

In order to proceed accordingly, agencies involved in air traffic control should promptly promulgate the challenges of implementing UAM in the future by seeking cooperation to ensure readiness in 4 key aspects: rules and regulations, technology, infrastructure development, and personnel development.

Rules and regulations should particularly focus on consumer safety without putting a burden on the operators, especially the Thai start-ups. It should also take into consideration various standards, for example the hardware standards that will follow the principles of airworthiness, and software standards of cyber security.

Technology should focus on the safe use of hardware and software technologies. Furthermore, data control and storage should be kept at a central domestic location in Thailand.

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Infrastructure development should focus on the physical properties, communication systems, hardware development processes, and the development of flight control and flight planning softwares that must be well maintained and continuously updated for safety reasons, and to lessen dependency on foreign countries.

Personnel development should focus on producing UAM production, services, and unmanned aircraft control personnel, and to legalize/license these professions.

Recommendations

Recommendations for the Adaptation of the Research Results

The results of the study on the use of Unmanned Aerial Vehicles for transportation in the future has found that UAM is an aerial transport system, forecasted to be implemented in foreign countries for transporting people and products around cities and suburban areas at the lowest altitude. It should be in use commercially from 2023 onwards, also some ASEAN countries might be able to perform flight tests in 2023. Thus, curriculum managers, college administrators, agencies involved in air traffic control, and the aviation industry should make use of the learnings from the UAM implementation in other countries to form a body of knowledge for their respective operations.

The study on the use of Unmanned Aerial Vehicles for air traffic control in Thailand in the future has found that organizations involved in air traffic control have begun feasibility studies on the implementation of UAM in Thailand revealing the possibilities of using UAM for commercial transportation, and to make Thailand the UAM research and development center for the ASEAN region. Therefore, the curriculum committee and instructors should be prepared to use the knowledge from these studies to develop curriculum and course materials that will respond fully to our country's needs. Also, leaders of organizations involving air traffic control should prepare mechanisms to support the utilization of UAM in Thailand, hence strengthening the global competitiveness of the Thai Aviation Industry.

Recommendations for Further Studies

Since the study on the use of Unmanned Aerial Vehicles for air traffic control in Thailand in the future found that the agencies involved in air traffic control should accelerate the cooperation from government and private organizations to build readiness and capabilities to implement UAM in 4 aspects: rules and regulations, technology, infrastructure development, and personnel development. However, this study is qualitative research conducted with in-depth interviews, thus, other methods of research such as quantitative research should be conducted on this topic to further verify this study's findings to provide benefits to the relevant authorities, government agencies, and private organizations, as well as to increase confidence in the study results.

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