

**A STUDY OF THE POSSIBILITY OF THE APPLICATION OF DRONES
FOR LOGISTICS INDUSTRY IN THAILAND**



**AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULLFILLMENT
OF THE REQUIREMENT FOR THE DEGREE OF
MASTER OF SCIENCE IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT
INTERNATIONAL COLLEGE
KING MONGKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG
2017
KMUTL-2017-IC-M-002-008**

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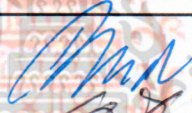


เอกสารนี้เป็นเอกสารที่สงวนไว้สำหรับการใช้งานเพื่อการศึกษาเท่านั้น ไม่อนุญาตให้นำไปใช้ประโยชน์ด้านการค้า
ไม่ว่ากรณีใดๆ ทั้งสิ้น อีกทั้งห้ามมิให้ดัดแปลงเนื้อหา และต้องอ้างอิงถึงเจ้าของเอกสารทุกครั้งที่มีการนำไปใช้



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Independent Study Certification
International College
King Mongkut's Institute of Technology Ladkrabang

Independent Study Title A Study of the Possibility of the Application of Drones for Logistics Industry in Thailand
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Place: International College, 8th floor, 55th Anniversary Chalermprakiat Building

KING MONGKUT'S INSTITUTE OF TECHNOLOGY LADKRABANG


(Assoc. Prof. Dr. Supat Kittiratsatcha)
Dean of International College
May 13th, 2017

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STUDENT NAME Ms. Chakriya Leelasiri

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ABSTRACT

Logistics system lies at the heart of business sector and many other industries. There are several modes of shipping including air, water, and land. Another shipping alternative that has gained increasing recognition in other countries is shipping by drone. In many countries, especially the United States, drones have been used in many shipping trials. Several products were delivered to the customers who reside within an appropriate periphery of the distributing center. The entities that have conducted the trials are predominant companies such as Amazon, UPS, FedEx, and 7-Eleven. It was reported that the results of these trials are satisfactory. These findings influenced the logistics industry to pay more attention to drones. Otherwise, companies and logistics providers, who are left behind in this new mode of shipping, may face competitive disadvantages. In Thailand, this shipping mode remains far-fetched and no company has conducted the similar yet. This study investigated and analyzed opportunities of the

application of drones in the logistics domain by Thai companies. It also explored appropriate types of businesses, related rules and regulations from the government authorities, ramifications and obstacles, as well as opportunities and possibilities. This study also included interviews of professionals related to the logistics domain about their opinions in various aspects of deploying drone to their business. Subsequently, the collected data was assessed in different dimensions in order to discover the conclusion on the possibilities using drone for logistics activities that may inevitably arrive in Thailand in the near future.



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ACKNOWLEDGEMENT

I wish to express my special thanks of gratitude to my advisor, Dr. Jaruwit Prabnasak who gave me encouragement, insight and expertise that greatly assisted this research that was great interest of me as well as Asst. Prof. Dr. Ronnchai Tiyaratannachai, my co-advisor, who spent his valuable time reviewing my work and gave me guidance and kind advice which helped me to get into the right direction at the right time. I am really thankful to both of them.

Furthermore, I would like to sincerely thank all my respondents for the support and willingness to spend some times with me on interviews.

Last but not least, I am most grateful to my family and friends who put their faith in me especially my brother, Police Colonel Varissiri Leelasiri and my husband, Surachai Jarujumpol who gave me unconditioned and continuous support during these 2 years of my Masters. Without their support, I would not have made it this far. I love you all.

Sincerely,

Chakriya Leelasiri

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CHAPTER 1

INTRODUCTION

It is currently an era of immediate communication. Corporations thus are required to adapt to a plenty of innovations in which some are able to completely alter the ways of living or business; one of the innovations is drones or aircrafts without drivers. Drones are developed and utilized in different ways such as war, bird's eye view cinematography, performance, racing, entertainment industry, and logistics. In this regard, it is noticeable that different applications of drones are independently utilized without having to ask for official authorization or involve with any laws. However, the aspect of logistics is extremely sensitive in the United States and Europe. There is great awareness in the attempt to apply drones to logistics processes in corporations such as Amazon, publishing companies, and e-commerce companies. These companies would like to deliver goods to their customers by utilizing drones. Additionally, a large number of companies or individuals have tried this method (Murray & Chu, 2015).

In Thailand, it is undeniable to be influenced by this global trend. If one is to learn and embark on utilizing this method first, one will greatly gain advantages over its competitors. Currently, there has not been a large number of studies on the application of drones for commercialization in Thailand such as logistics, which does not further offer effects, benefits, and shortcomings of this. Most importantly, there has not been any acts or laws on utilizing drones for commercial purposes, especially for start-up companies which are exponentially on the rise in Thailand. Normally, it is found that a new group of entrepreneurs does not wait until everything is prepared and start their businesses. With a unique trait, this group of entrepreneurs is known for

creating new ideas to attract funding or Venture Capital without having to consider all-round preparedness. To be more illustrated, UBER which is perceived as being placed between not entirely 100 percent legitimate and not entirely 100 percent illegitimate is simultaneously operated and under the legal process of legitimizing the very business. Hence, is it necessary to wait for all-round preparedness and later utilize drones? The result could be revealed in two different perspectives: the side that waits and the side that does not wait (Martin, 2016).

From the perspective of startup businesses, it is however new; the legal conclusion is rather ambiguous, which further allows entities to conduct their business outside the legal context. Although this kind of businesses can be conducted, it is likely to be faced with following dilemmas. One of the most significant dilemmas is the replacement of conventional technology with new technology that enhances services. As the laws have not covered this kind of business, it is therefore conducted without inspections; this includes the lack of means of solution such as safety and standard inspections, and the lack of accountability of service providers once damages to property or people occur.

This study focused on the possibility of the application of drones in the industry of logistics and supply chain through different dimensions including laws, business, and services. The data was collected from case studies from overseas and interviews of a group of logistics and supply chain entrepreneurs in Thailand, as well as concepts notions of utilizing drones in their businesses and possible limitations. The data was further analyzed for the possibility and effects in relevant aspects, which include presenting practical applications for commercial purposes that are viable for the Thai market.

1.1 Problem Statement

Although foreign countries have witnessed an increasingly extensive utilization of drones, it is still in the process of examining and studying the possibility for using drones for business and logistics applications along with its related laws and regulations. For Thailand, the trace of this has not been discovered, which may be caused by some limitations or factors. Additionally, formal studies on this subject have not been conducted.

This study thus focused on finding factors, which would additionally enhance the possibilities of the application of drones in the business area, specifically in the field of logistics. In this respect, the main concerns for this study cover preliminary problems of utilizing drones in actual business circumstances including:

1. The limitations of the regulations of the application of the drones in the business sector of Thailand
2. The preparedness of the application, specifically on the aspects of hardware, software, personnel, and facilities
3. The appropriate forms of the application of drones

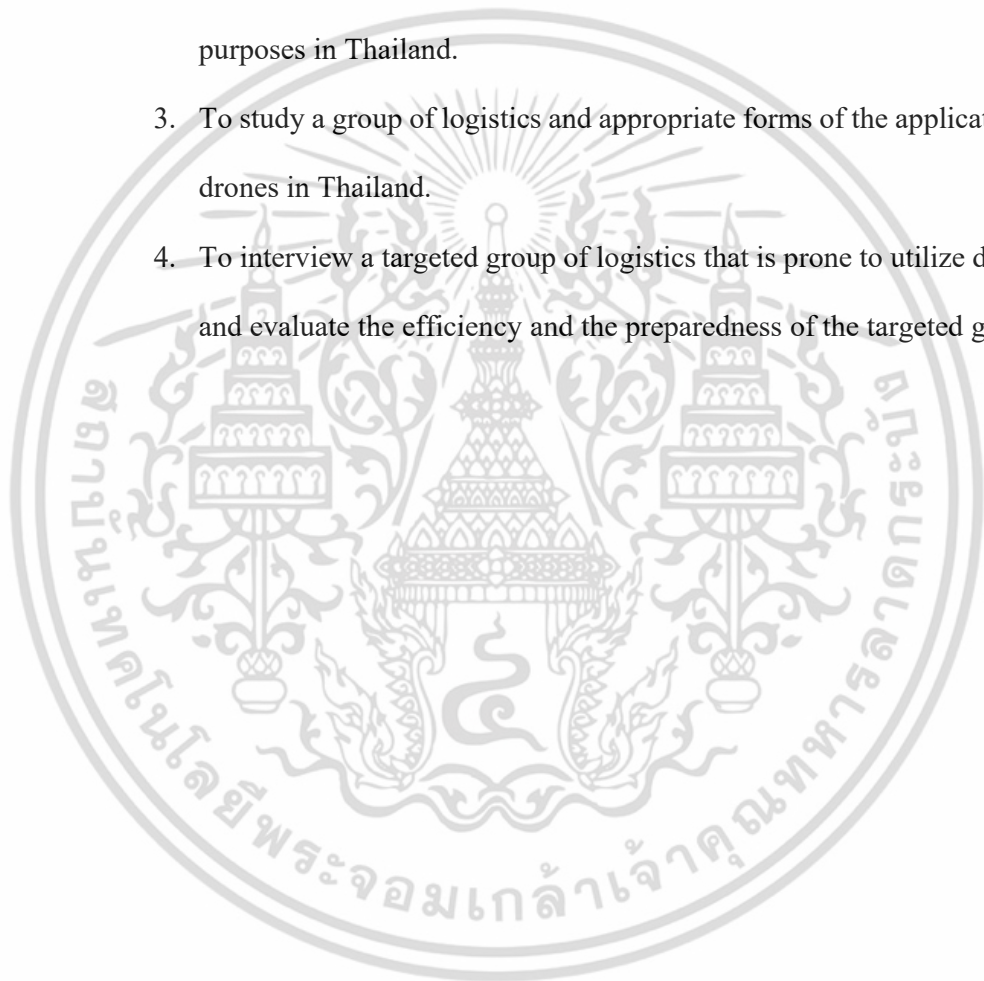
1.2 Objectives of the Study

1. To gather and review information about the application of drones in domains relevant to logistics.
2. To investigate different aspects of limitations and possibilities of the application of drones for commercialization in Thailand.
3. To explore opportunities and responses from the commercial sector in the application of drones in different domains.
4. To study appropriate forms of utilizing drones in the logistics industry.

1.3 Scope of the study

Drones can be utilized in diverse and wide manners. One of them is in the business sector, which is considered as a breakthrough in the contemporary era of business. This study focused on the following points:

1. To study the drone trials in the logistics sector in other countries.
2. To study the regulations of the application of drones for commercial purposes in Thailand.
3. To study a group of logistics and appropriate forms of the application of drones in Thailand.
4. To interview a targeted group of logistics that is prone to utilize drones, and evaluate the efficiency and the preparedness of the targeted group.



CHAPTER 2

LITERATURE REVIEW

Development of drones has been fostered concurrently with the demand for using drones in different applications. In recent years, there has been a rapid expansion of the drone trials in logistics and retail companies in the United States, e.g. Amazon, 7-Eleven, UPS, DHL, and FedEx (French, 2016). Moreover, there have been drone developments and trials for transporting passengers. The drone development takes place in continuum. Factors that are likely to keep pace with or decelerate drone applications lie in the sphere of law. Despite having a wide range of benefits, drones pose concerning threats as well. With the novelty of the drone technology, companies have not yet conducted the study on drone applications and their impact on business in the case of the future prevalence of drone applications.

This chapter discusses different sources of data in relation to drones in diverse viewpoints. This is to point out the advantages of drones and the limitations of drone applications. In this respect, this information is to be first designed as a suitable methodology for data accumulation and analyzed in comparison with case studies in other countries, which are presented in the next chapter.

2.1 History of Drone

Unmanned Aerial Vehicle (UAV) have been increasingly more popular through a variety of applications. Many forms of flying objects have been airborne for several millennia such as sharpened stones, spears, boomerangs and kites (Clarke, 2014). In 1783, human achieved its first flight using lighter-than-air balloons or aerostats. In 1849, Australia sent air balloons with loaded explosions to attack Venice. About 150

years later, spy balloon was roped 15,000 feet above Afghanistan to transmit live video (Bumiller E, 2011). In the 19th century, several aircrafts were developed in many countries. The first fixed-wing airplane was achieved in the USA in 1903 before it had been constantly produced and developed mainly for war (Clarke, 2014). After war, UAV was utilized in other domains more, which can be categorized into two major domains: the first domain is the government and military sectors and the second domain is the private and commercial sectors (Volovelsky, 2014).

One of the reasons for the popularity of drones is the fact that drones can hover in the air for a long distance without having to be controlled by anyone. Additionally, the current development lessens the price significantly, which makes anyone be able to own a tiny aircraft at his or her fingertips. Supposedly, if one could own this tiny aircraft, what would one do with it? The obvious benefits of drones are as follows (Harriman & Muhlhausen, 2013):

- Having the ability to hover in the air.
- Having a small size
- Having an inexpensive price
- Having the ability to operate in a long distance
- Having the ability to be controlled with an automatic system
- Having a low price of maintenance
- Having the ability to be installed with gadgets such as cameras, microphones, or objects with light weights.

Hence, there is no doubt that drones would greatly contribute to the commercial sector while lessening budget and creating advantages to the corporate. Perhaps, drones may be further improved to the extent that they could carry humans; then, the era of ground commuting would come to an end (The Economist, 2015).

The main obstacle of today is that technology moves faster than law and this could limit the application of drones to the government sectors only. It is, however, necessary to study options of the useful application of drones as much as possible and brace corporates for the actual application. The different forms of trials are equally significant so that once the limitations and laws were lifted, the most prepared would launch the model out of the blue; the followers might not be able to grasp the trend or have no chance to grasp the trend as they would have been likely to close down from not having the ability to adapt to the rapid change of the business world (Wolf & Declet, 2016).

Startup businesses with new technology mushroom in every corner and are prepared to face the new forms of business risks that are to shake the status quo without any care to limitations and laws enforcement. Examples are seen from UBER (New Scientist, 2016) or AIRBNB (Bin Fang, 2016). Although drones seem to be far-fetched, but they might appear out of nowhere and deliver pizzas at anyone's backyards (Holden, 2016).

2.2 Applications of Drones

Drones can be categorized into 2 main groups: the military or governmental group and the private group that utilizes drones for commercial purposes or individual purposes. The following detail shows different usages of drones (Volovelsky, 2014).

1) Government Group

In the aspect of military matters, these drones have been utilized in wars many times. American and British armies utilized drones in military missions in Afghanistan, Iraq, and Pakistan (Blackhurst, 2012). It is likely possible that wars, in the current era, are to involve drones as the main equipment. In the present, many countries produce

drones for military purposes. Israel, China, Nigeria, Iran, United States, Pakistan, Somalia, South Africa, United Arab Emirates, Iraq, and United Kingdom were reported to be main countries with armed drones (BBC News, 2012).



Figure 2.1 Predator drone operated by U.S. Office of Air and Marine

Source: Fortune Tech. (2016). All of These Countries Now Have Armed Drones. Retrieved from <http://fortune.com/2016/02/12/these-countries-have-armed-drones/>

In 2013, it was reported that the United States owned approximately 7,500 operating drones, ranging from moderate surveillance drones to the more proverbial models namely the Predator (**Figure 2.1**) and Reaper. These models are used for the purpose of targeted killings in countries such as Pakistan and Yemen. In contrary, the second largest user and supplier of drones, the Chinese fleet, is thought to be smaller than the United States by several thousand drones at the minimum (Boyle M. J., 2014).

Furthermore, the United States has witnessed diverse technological advancement that benefits drones in terms of range and strike capacity, and in which its fleet has ascended beyond its competitors. Similarly, nations such as Britain, Israel, Russia, and the United Arab Emirates have increasingly conducted drones programs and have undertaken investments in research and development. They nevertheless

continue to follow behind the United States in the aspects of the number and the advancement of the drones. It was concluded by a variety of spectators that the United States will remain a predominant user of drones in the future to come. This is rooted in the fact that the American companies have concentrated on the technological faculty of knowledge and the expansive infrastructure in the domains of research and drones development (Boyle M. J., 2014).

The United States does nonetheless not take the role of a dominant exporter in the current drones market. Israel, on the other hand, has come to be the global supplier which provides this technology to a considerable number of other nations under the premise of domestic and military endeavors. Currently, drones have proliferated to most established militaries located in the developed parts of the world. This condition has been made possible by the exports of the United States and Israel, and the commitment of other nations on the development of drone export markets. During the years of 2004 to 2011, there is an increase of the number of states conducting UAV programs by double; the number has gone from 40 to 80. More than three quarters of nations around the world have initiated their drones programs, varying from small programs to increasing multifaceted programs with the purpose of combat, surveillance, and civilian applications (Boyle M. J., 2014).

According to a 2012 United States Government Accountability Office (GAO) report, the number of countries deployed UAV system for military, commercial or civil has grown from 41 countries in 2004 to 76 countries by 2011 (GAO, 2012).

From Figure 2.2, it is recorded that, in 2014, there are 35 countries utilizing drones to access military information. A total of 439 units of drones were transferred to a number of countries. In this case, England is the country with the highest number of

drones import at 33.9 percent, followed by India and Italy having the percentage of drones import at 13.2 and 9.8, respectively. The average price of drones is 40 million dollars per system. In 2013, the United States transferred Global Hawk drones, which cost 130 million dollars, and is considered to be one of the most expensive drones in Germany. Additionally, there were orders from other entities and countries such as NATO, Australia, Japan, and South Korea (Arnett, 2015).

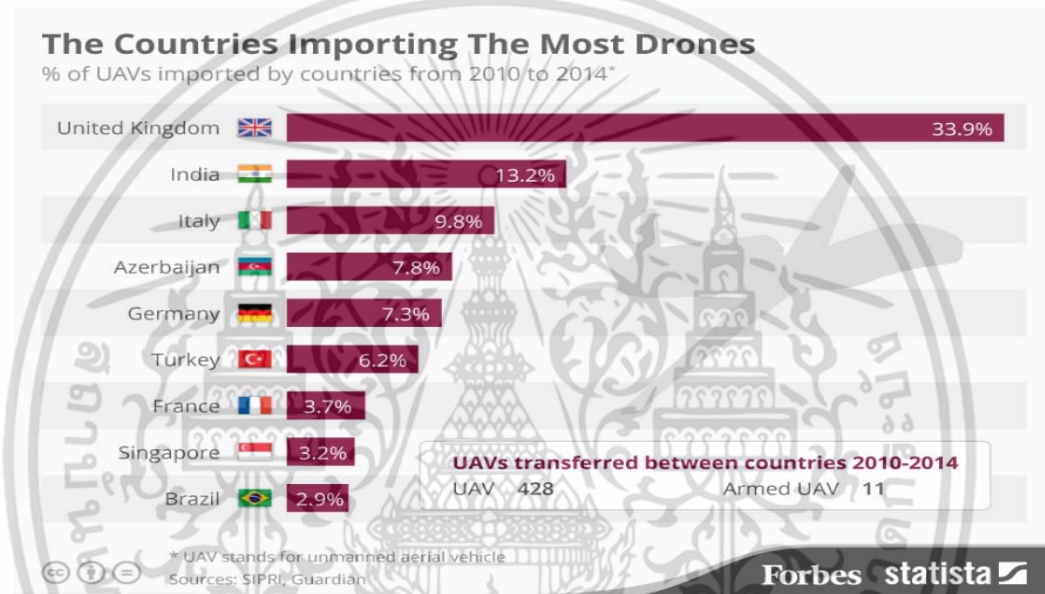


Figure 1.2 Importing drones by countries

Source: McCarthy, N. (2015, Mar 18). The Countries Importing The Most Drones. Retrieved from <https://www.forbes.com/sites/niallmccarthy/2015/03/18/the-countries-importing-the-most-drones-infographic/#c2314568c3de>

Drones utilized for governmental or military matters were mostly exported to Israel in which there were 165 units exported during 2010-2014, followed by the United States with 165 units. Even though China has come to a significant actor in the drones market utilized for military purposes, the export proportion is merely at 0.9 percent, which sees a far distant from Israel that began exporting since 1985 and is currently recorded with the proportion of 60.7 percent as shown in Figure 2.3. It is nevertheless

believed that within a few years ahead, China will certainly become the leader of drones production and export for military purposes (Arnett, 2015).

Biggest drone exporting countries

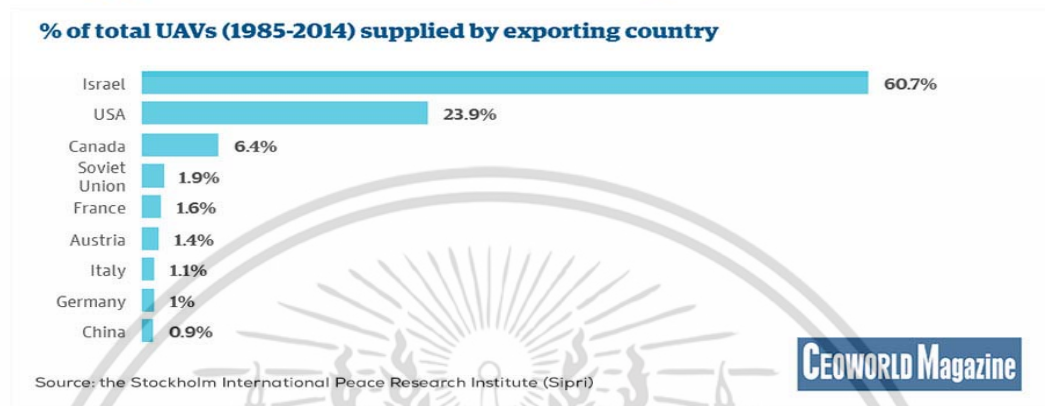


Figure 2.2 Drone exporting countries

Source: Dhiraj, D. A. (2015, Mar 16). Global Drone Trade: World's Largest Importing And Exporting Countries. Retrieved from <http://ceoworld.biz/2015/03/16/global-drone-trade-worlds-largest-importing-and-exporting-countries/>

2) Private Group

Drone application in the domain outside of military purposes could be used for different purposes such as entertainment, photography, agriculture, as well as business in which they can be categorized accordingly (AirVid, 2014). Some applications of drone are summarized as follows:

Videography/Photography

- Movies, Kids sporting events, Weddings, Golf Course, Promotional Videos for Products / Services, 360 Panoramas, Tourism, News, Sports Event Coverage, Live Event Coverage, Concerts, Traffic Reporting, documentary (Rao, Gopi, & Maione, 2016)

Emergency

- Search and Rescue, Flooding, Damage assessment, Fire Detection (e.g. fire towers), Coast Guard, and Wildfire (Hudson, 2014)

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Education

- University Science and Technology Studies, Aeronautical Engineering and Studies, Software Development Studies Courses, Industrial Engineering Studies Courses, Robotics Studies and Engineering, 3D Printing and Technology Studies Courses (Marks, 2012)

Environment

- Environmental Monitoring, Waterway Monitoring, Ice Flow Monitoring, Wildlife Conservation, Wildlife counts / Mapping of animal population, Marine Biology – Whale health monitoring (Harriman & Muhlhausen, 2013)

Aviation

- Flight Training - Cost Reduction and Increased Pilot Safety (Gabriel G. De la Torre, 2016)

Meteorology

- Weather Atmospheric Studies (Harriman & Muhlhausen, 2013)

Engineering

- Civil Engineering Design Mapping, Asset monitoring, Digital elevation modeling, Thermographic Imaging

Mining/Oil & Gas

- Oil spill tracking, Pipeline monitoring, Environmental assessment, Pit Survey

Mapping

- Land cover mapping, Forestry mapping, Forest health, Disease detection, Water management support mapping, Wind Farm

Mapping, Solar power plant mapping, Transmission Line mapping, Archaeological Site Mapping, Surveying, Tree Mapping (Harriman & Muhlhausen, 2013)

Construction

- Virtual view from new construction, Aerials documenting whole site, Construction Planning, Identify potential issues, Construction Progress Monitoring, Marketing for Construction, Surveying (Harriman & Muhlhausen, 2013)

Agriculture

- Pest control, Land Use, Crop type, Plant count, Soil type, Soil moisture, Growth stage, Plant Height, Plant health, Yield Monitoring, Soil Classification, Cattle Monitoring (Harriman & Muhlhausen, 2013)

Miscellaneous

- Advertising, Delivery (Figure 2.4), transportation, etc.



Figure 2.3 DHL delivery drone

Source: DHL Press Release. (2016). Successful Trial Integration of DHL Parcelcopter into LogisticsChain, http://www.dhl.com/en/press/releases/releases_2016/all/parcel_ecommerce/successful_trial_integration_dhl_parcelcopter_logistics_chain.html (accessed Mar 21, 2017). Bonn.

As there is a variety of drone application, drones can be categorized into different types; such categories, however, have not officially been identified. In Figure 2.6, they can be categorized in accordance with three types of flying distances including (Harriman & Muhlhausen, 2013):

- 1) Long flying distance (Figure 2.5)
- 2) Medium flying distance
- 3) Short flying distance.



Figure 2.4 High attitude long endurance drone

Source: Ackerman, S. (2011). Pentagon: Drones Can Stop the Next Darfur. Retrieved from <https://www.wired.com/2011/02/drones-vs-darfur/>

Apart from the above factors, they can be categorized in accordance with sizes, weights, and control systems including the type controlled by men and the automatic type (Harriman & Muhlhausen, 2013).

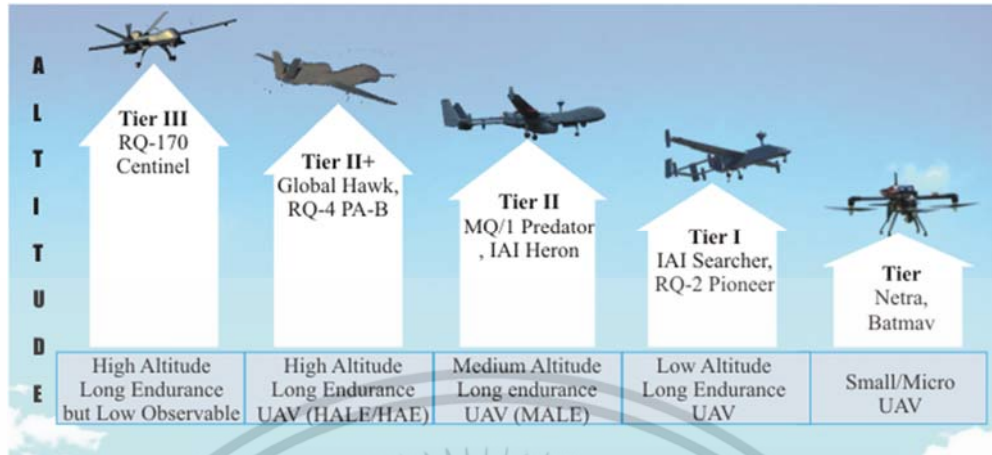


Figure 2.5 Types of drones

Source: Nagpal, K. (2016). Unmanned Aerial Vehicals (UAV) Market. Retrieved from <http://www.defproac.com/?p=2041>

World's first passenger drone



Figure 2.6 Ehang184 at Consumer Electronics Show (CES)

Source: Vaszary, Z. (2016). EHang 184 is a Manned UAV You Will Never Get to Fly. Retrieved from Dronthusiast: <http://www.dronethusiast.com/ehang-184-is-a-manned-uav-you-will-never-get-to-fly/>

At present, the advancement of drones has ascended to the point where one passenger can be transported to a certain place by simply identifying the location of the destination and pressing one. Figure 2.7, Ehang184 Drone that carried one passenger

เอกสารนี้เป็นเอกสารที่สงวนไว้สำหรับการใช้งานเพื่อการศึกษาค้นคว้าเท่านั้น ไม่อนุญาตให้นำไปใช้ประโยชน์ด้านการค้าไม่ว่ากรณีใดๆ ทั้งสิ้น อีกทั้งห้ามมิให้ตัดแปลงเนื้อหา และต้องอ้างอิงถึงเจ้าของเอกสารทุกครั้งที่มีการนำไปใช้

from China was launched in Consumer Electronics Show (CES) which is held at the beginning of every year in Las Vegas, and Nevada. This particular version of drones can be fully charged within 2 hours, loaded to 99 kilograms, and fly for 23 minutes. The model is designed to fly at 300-500 meters above the ground (the maximum flying distance is 3.5 kilometers), meanwhile the fastest speed is 100 kilometers/hour. In terms of flying upward, the manufacturer states that the passengers can simply set the GPS coordinates to the destination by pressing the “take-off” button and “land” button installed only on the front of the tablet screen. As for the passenger room, it is constructed with a one-passenger space and a rack for small luggage. Additionally, there are an air conditioning and a light for reading. As the propellers are furled, the drone owners can store them in typical garages (Rundle, 2016).

Shang Hsiao, Ehang co-founder, revealed that the prices of drones are 200,000 - 300,000 US dollars or approximately 10 million baht. However, had there been any problems during the flight, there are not any systems that can assist passengers. The company is planning to utilize a remote control that can control the safety of passengers. Currently, there have been more than 100 tests on Ehang184 at moderately high places and there have been tests on drones that actually carry humans (Phillips, 2016).

In the future, there may be the consecutive development to adjust limitations such as amounts of passengers, luggage weights, central control systems, safety regulations, as well as law adjustment that are more appropriate to accurate drone application in terms of transportation and logistics. Once this becomes reality, it might be the end of automobiles on the roads (Vaszary, 2016).

Engineering and Technology

According to the announcement of the Ministry of Transport imposing that drones are not allowed to weigh more than 25 kilograms, and hover above 90 meters.

If there is an absolute necessity for the application of drones, an approval from the authority is to be granted case by case. In Thailand, the development of drones has not yet taken place, and in which it might not be so. Therefore, it would be better to follow the application of drones from the leading users as the case study in the area of appropriate uses of technology for businesses in Thailand (CAAT, 2015).

One interesting example is the Amazon Prime Air, which is illustrated in the next section. It has undergone actual trials for shipping products by drone to customers in England. The drones were developed to have an ability to fly and land vertically, as well as fly horizontally towards the destination. In this case, it was a blend between a plane and a helicopter. Generally, drones are able to fly to 100 meters at the highest, with the maximum speed of 100 km/h. Amazon's drones are able to load products under 2.26 kilograms. Additionally, one shipping is only for one destination. Once the shipping is completed, it has to be recharged at the distributing center (Amazon, 2016).

For the intriguing technological aspect of the application of drones in the logistics domain, it is vital that drones are characterized by diverse attributes that are different from typical drones in terms of hardware and software, which are shown in the section of significant data as follow: (Bristeau, Callou, Vissière, & Petit, 2011)

Hardware:

- Capability to carry weight up to 2.5 kg.
- Sensor to detect speed and obstructed object
- GPS system
- Camera with 360 view
- Microphone
- Radio antenna

- Equipment to handle the box or it can be designed to drop the package with tiny string in certain height
- This drone must have a specific color or design to notice that it come from which company to avoid misunderstanding with other drones

Software:

- Centralized control
- Auto setup routing when assign destination
- Auto re-route when detect obstructed object
- Display speed, height, and time to reach target
- Tracking system
- Verify target and drop-off system

2.3 Business Models

In Thailand, the business-based application of drone has not yet taken place. There are nevertheless trials of drone application in companies in the field of logistics and retails such as UPS, FedEx, Amazon, and 7-Eleven. Other companies also appear to prepare themselves to apply drones into their own business contexts. This is due to the fact that drones are able to enhance the capacity of shipping and lessen funds in different aspects, especially in terms of personnel in which its expenditure is quite high in comparison to a shift to using drones. There is a possibility that companies without drones might be disadvantageous in several aspects especially in terms of the image that is required to be modernized. The supposed companies might even be taken over by other companies. In a worse scenario, those companies might have to go out of business (Shedlock, 2016). Nokia and Kodak are the prominent cases for lacking to proper adaptation in terms of technology change.

There is some consideration for the trend of the business-based application of drones. It is however not in an official manner. This study will survey the possibility of using drones in some groups of business such as logistics, by creating a business model, necessary technological apparatuses: hardware and software, as well as interviews of the target business group, which are to be used as fundamental data for further analysis of opportunities and possibilities of the technology of drone. However, there are three aspects to be considered for any company to initiate a new service including (Alexandre Joyce, 2016):

- 1) The integration of key components and functions or parts to deliver value to the customer.
- 2) The interconnected of these three factors within the organization, supply chain, and other partner networks.
- 3) To generate value or create profit by these interconnections.

Studying of drones in the field of business requires the use of two popular tools to analyze the potential of a business, which are Business Model Canvas and SWOT analysis. Creating a variety of business models will demonstrate the pros and cons in different aspects where the most appropriate and effective business model will be chosen and applied for the business.

Strategy Formulation by the Business Model Canvas

The Business Model Canvas is an apparatus for visualizing business planning in a comprehensive manner. This apparatus formulates strategies and tactics, evaluates the success of plans, and selects business models that are effective and appropriate. The Business Model Canvas classifies the structures of planning and formulates strategies into 9 building blocks, which are interrelated, and provide comprehensive lenses to businesses. The Business Model Canvas is comprised of main components: customers,

products/ services, business structures, and financial sensitivity. Figure 2.8 illustrates the Business Model Canvas resembles a prototype of strategies which are operated by organizational structures, procedures, and systems; which manage business planning in a comprehensive manner (Cle-Anne Gabriel, 2016).

1. Customer Segments is a target group that is to be investigated. Identifying an accurate target group lies at the heart of the business model; in this vein, the target group has to earn revenues to the business.

2. Value Proposition (values of products/services): by how identifying products/ services benefit customers, which is a factor causing customers to select our product or service over the competitors.

3. Channels refer to channels for communication, distribution, trading, markets that are used by companies to communicate and get in touch with customers. Selecting a well-blended ingredients and reaching out to targeted customers are of important paramount and greatly beneficial to business.

4. Customer Relationships: any business should identify types of customer relationships, and in which there are different degrees from answering machines or automatic job-finding machines to personnel who is sensitive to the needs of customers.

5. Revenue Streams refer to revenue of the business excluding expenditures.

6. Key Resources refer to resources that are significant to successful business planning, which includes physical resources such as tangible apparatuses including machines, financial resources, intellectual property, and human resources.

7. Key Activities refer to important activities that are executed to accomplish the objective. Main activities include production, service provision, products/ services that solve problems for the customers, business platform building, and network building.

8. Key Partnerships: in the current context of business, building networks is important and essential. The advantages of having business networks are for maximizing benefits of the business, lessening risks, and accumulating business resources.

9. Cost Structure refers to the structure in the domain of budgets including all the budgets following business operations determined by the company, such as the budget for building the value of products/ services, the budget for reserving customers, the budget for resources, and the budget for services. The calculation of budgets can be conducted by key resources, key activities, and key partnerships.

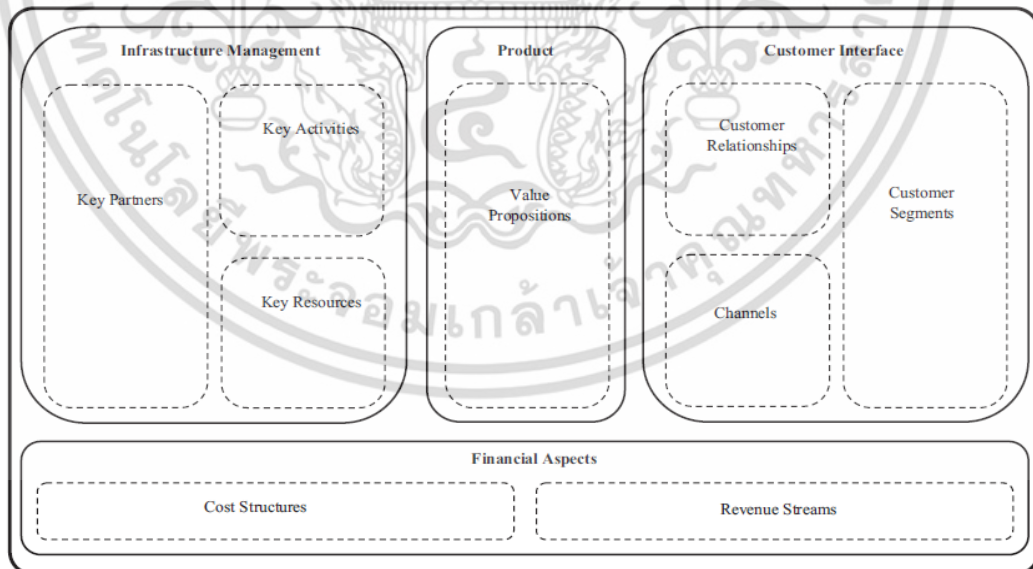


Figure 2.7 Business Model Canvas

Source: Cle-Anne Gabriel, J. K. (2016). Business models for model businesses: Lessons from renewable energy entrepreneurs in developing countries. *Energy Policy*, 336–349.

SWOT analysis

SWOT is an analyzing method which is typically used for the purpose of assessing and placing resources and environment of organizations in four domains: Strengths, Weaknesses, Opportunities and Threats (Boonyarat Phadermrod, 2017). This method will be used to analyze and confirm the possibility for using drones for business and logistics applications in Thailand.

Strength and Weaknesses are considered to be elements which can be controlled internally. These elements support and impede organizations in the course of their achievements. On the other hand, Opportunities and Threats are considered to be elements which can be controlled externally. These elements can either allow or disallow organizations in the course of their achievements. The recognition of these four elements allows the organizations to foresee their core capacities in terms of decision-making, planning and creating necessary strategies (Boonyarat Phadermrod, 2017).

The first procedure in developing a system of strategic planning requires business managers to start identifying and evaluating these elements, which can pose as an assistant or an obstacle in the course of the companies' reaching its highest potential. Despite the importance of strategic elements, its degree of importance is bound to be in continuum; for a dynamic environment is an intrinsic nature of every company. Hence, the permanence of this analysis remains (G. Houben, 1999).

Aiming for the successful operation, the companies ought to make use of strengths, and divert their attention from weaknesses. In the aspect of the process of strategic management is thus a vital element in addressing internal strengths and

weaknesses. In this respect, familiarizing themselves with opportunities and threats posed by external factors can lead companies to successes. (G. Houben, 1999).

Moreover, a SWOT analyzing method can be used by businesses to conduct assessments on changing conditions and respond respectively in a proactive manner. Further, the companies are recommended to conduct a yearly meeting on strategy reviews that engage a SWOT analyzing method as an initial introduction (Berry, 2017).

2.4 Related Laws and Regulations

On August 27, 2016, there was an announcement issued by the Ministry of Transport of Thailand on the regulations to control the use of unmanned aircrafts. There are two sizes of drones approved, which are drones under 2 kilograms and drones under 25 kilograms. As stated in Section 8 of the announcement, drones that are over 2 kilograms, but less than 25 kilograms are to be registered to the director general of Ministry of Transport. Mentioned in Section 18, as for drones over 25 kilograms, approval from the director general is to be granted in accordance with different cases. More importantly, the age of drone users is additionally limited to be over 18 years old and 20 years old. For the case of drones over 2 kilograms, but less than 25 kilograms, users are required to examine drones' conditions before launching and be aware that some locations such as airports, communities, and governmental agencies are out of drones' perimeter. In addition, drones are to hover over the heights of 3 meters and below 90 meters (CAAT, 2015).

In some cases, there might be other means of laws that are to be taken into consideration such as Division 2 on ownership of property and exercise of ownership. In Section 1335, ownership of property may be of areas beyond real estate and beneath real estate. Another law related to drones is the Copyright Act. There were cases about

trespassing of drones including recording outdoor sport competitions and uploading the clips onto YouTube (Youngchoay, 2010).

In other countries, laws controlling the use of drones emphasizing similar matters such as in England, Civil Aviation Authority or CAA has issued “Drone code” which simplifies significant points of regulations as follow (Civil Aviation Authority, 2016):

- Drones are to be controlled in areas that can be seen at all times and hover under the height of 400 feet (same as in the US, Europe and Australia (Brooks, 2012)).
- Drones are to be controlled to keep distance from helicopters, airports and airfields
- Unless drones are to be controlled with conscience and awareness of safety, users might be prosecuted with legal charges.
- Drones installed with cameras are not allowed to hover near people, vehicles, or buildings in the perimeter of 50 meters. Additionally, they are not allowed to hover above areas with crowded population such as concerts and sport competitions.

Many countries require drone operators to have license or certificate granted by aviation authorities. In the United States, the Federal Aviation Administration or FAA first authorized permits for the use of drones in 1990. Now, there are approximately 1,500 drones registered (327 permits are still active). These permits were issued to law enforcement agencies such as local police stations, universities, the Department of Homeland Security, and the Federal Bureau of Investigation. It is likely that the number of permits tend to increase (Volovelsky, 2014).

The European Aviation Safety Agency has authorized approximately 400 permits, and there are over 400 drone development projects in 20 European countries (Volovelsky, 2014). The EU and the US have signed a bilateral agreement to strengthen accelerated cooperation on the integration of drones into transatlantic civil airspace (Jones & Topfer, 2014).

Countries that require drone operators to have a pilot license, certificate, or permit are Australia, Austria, Bahamas, Bahrain, Bangladesh, Belarus, Belgium, Belize, Bermuda, Botswana, China, Colombia, Costa Rica, Canada, Cyprus, Czech Republic, Dominican Republic, Fiji, France, Ghana, Hong Kong, Hungary, Indonesia, Jamaica, Kenya, Madagascar, Malaysia, Malta, Mauritius, Namibia, Netherlands, Oman, Panama, Philippines, Poland, Romania, Rwanda, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Thailand, Trinidad and Tobago, Uganda, Ukraine, United Kingdom, Uruguay, Uzbekistan, Venezuela, Vietnam, Zimbabwe (Storyhunter, 2016).

In the past, militaries in countries such as the United States, the United Kingdom, and Austria usually used surveillance drones to operate surveillance endeavors in some areas in Iraq, Pakistan, and Afghanistan. In the past five years, apart from military and recreational spheres, the applications of drones have been stretched to the commercial sphere as well (Rocci Luppicini, 2016).

Drones first entered the EU policy discourse in 2002, and according to the European Commission's declared target, by the year 2028, civilian drones will be fully integrated into European civil airspace. There are a lot of differences in regulations of military and civilian application of drones. Regulations for military drones have been developed, and in which they only involve a limited area of activities in a particular airspace. As for the applications of civilian drones, the impact is relatively insignificant in the case of being compromised. The drone applications by civilians have hindered

regulations in the commercial and private domains. The source development of technology has lessened this impact, which has a dilemma in keeping pace with the changes. As usual, technology however exceeded beyond the regulatory procedures. This being the case, the ramifications for the all-embracing acceptance and application of drones as a viable apparatus thus took place (Rao, Gopi, & Maione, 2016).

Moreover, there are two factors that concern the public when it comes to the private drone applications: privacy and safety. Despite many positive applications of drones and its online reputation as a source of entertainment, there is still a controversial debate on drones' inappropriate behaviors. Due to the ambiguity of regulation imposition on the matter, drones have been witnessed to arbitrarily hover around leading relevant agencies to feel uneasy and uncertain about drone usages. The property rights and safety of the public have not yet been assured by the regulations. Involving more than a single stakeholder, this process includes the administrative government at all levels, manufacturers of drones, software distributors, and the users; all of which own personal motivations. Similar to the nature of other growing technology-related products, the customers always aspire to have a variety of choices and accesses. However, businesses aim to produce and distribute products without any obstacles under the needs of customers. Agencies, which regulate and enforce relevant laws and regulations are required to cultivate confidence in their competency to manage violations (Rao, Gopi, & Maione, 2016).

2.5 Obstacles

Despite gaining gradual attention from a variety of great applications to different activities, drones can be manipulated for formidable usages. There is a concern towards the possibility of drones being used in crime and terrorism, terrorism, which

would be difficult to manage. Drones may be spotted delivering goods over the prison wall. There is also a concern that drones may be used to load dangerous weapons for terrorism. The most concerning issue is the possibility of drones being attached to nuclear weapons or being used to target significant strategic areas such as nuclear power plants, arsenals, and governmental offices (Bitzinger & Leah, 2016). Hence, the utilization of drones is a sensitive matter that requires all-rounded consideration, appropriate regulations, and preventive measures from improper usages (Milmo, 2015).



Figure 2.8 Pessimistic of drone in security perspective

Source: McFarland, M. (2016, June 7). Why America's drone problem may not be as bad as some think. Retrieved from <https://www.washingtonpost.com/news/innovations/wp/2016/06/07/why-americas-drone-problem-may-not-be-as-bad-as-everyone-thinks/>

Since drones are not widely used in Thailand, yet there was no incident leading to legal charges. Nonetheless, there were different cases occurred in other countries that brace ourselves for appropriate solutions.

In the United Kingdom, the total sales of drones gradually increase. Maplin, famous electronic store, has sold a number of 17,000 drones within a period of 12 months (McGowan, 2015); the figure has risen 100 percent from last year.

This greatly increase of drone has caused many violent issues and resulting in higher number of reports from police. Dr. Alan McKenna from Kent Law School asked

about reports on drones from police in which he received abundant data of 441 reports in 2 years, which is considered to be a great increase. In April to August 2015, there are 27 reports compared to the same period in 2014 with a number of 2 reports (Lowbridge, 2015).

For example, Nigel Wilson was charged for posting a video clip on YouTube. The video contained footage of a football competition near London landmarks. He was consequently fined for £1,800 pounds in September (Lowbridge, 2015).

Another case was about Stefan Michalak who intended to capture pictures of the exterior of the Natural History Museum on his birthday. The security officer prevented such action and took him to the authority for interrogation that lasted for 4 hours due to the fact that he was suspected to be a terrorist (Lowbridge, 2015).

Although the popularity of drones is rising, it is possible that anybody may encounter danger or violation of privacy. Drones, however, are not simply unfavorable. The question is about the appropriate forms of regulations and control that are to be imposed to create the proper and accurate condition of drone application. Hence, it may be necessary to learn and take a test for the approval of drone ownership in which drone users are obliged to be informed of drone control laws and other relevant laws as well as possible danger posed to others (Rao, Gopi, & Maione, 2016).

Another concern of using drone is the geography of Bangkok, which typically associates with high rise buildings, skyscrapers and obstacles (Arifwidodoa & Tanaka, 2015). It consists of untidy telecommunication wires, cables and optical fiber lines, and the electricity authorities' power lines which could be the obstacles of flying drones and could also cause danger to pedestrians and residents (FERNQUEST, 2015). Many locations are in the dense area, which is surrounded by a number of buildings including

condominiums, hotels, office buildings, hospitals, malls, and government institutes (Sintusingha, 2006).

2.6 Case Studies

At present, the changes of the forms of business progress in a swift manner. Had a company been sluggish or been reluctant to adapt, an unexpected impact may occur to the company. In this case, many companies in the United States recognize this matter. An entity that increasingly comes into play is drone. A variety of industries foresee the opportunities in applying drones into the contexts of different forms of businesses for various purposes. For instance, an industry in connection with logistics perceives that drones can be utilized to lessen the production cost and enhance the rapidity of shipping. Alternately, drones can be utilized to store and reach products that are placed on the racks in the warehouses (Lee, 2016).

The formal utilization of drones is nevertheless not simple. There are several impediments to be taken into account. In this respect, the main problem is concerned with legal limitations, followed by the efficiency of drones. During this period where the law does not facilitate the utilization of drones, a diversity of companies begin testing drones in different manners of operations, especially the logistics industry such as FedEx, UPS, and a group of electronic commerce such as Amazon and Domino Pizza. Many companies, especially in logistics and retail industries, are keeping their eyes on these trials. This is because, given that the approval of the application of drones in the business domain is to be granted, companies that are prepared would be greatly advantageous in the aspect of advancing its position to be the leader, and immensely elevate the market share. This is regarded as a turning point of the future business.

Those who are unprepared may disappear from the market in the blink of an eye (Lee, 2016).

Drone in new era has been wildly accepted and exploited by commercial sector. In 2005, many companies find the opportunity of applying drone to their business. Table 2.1 shows the development of drone service in transportation field from 2005 and project to 2018.

Table 2.1 Development of transportation drones

Year	Development
2005 – present	Many big companies such as Amazon, Google, UPS, DHL, and others in U.S. have tested drones to deliver their packages to their customers or some assigning locations.
2014 – present	Commercial delivery drone pilots began. DHL launched its first commercial drone delivery for the German Island of Juist in 2014. Mattemet has been running drone deliveries in Switzerland, Haiti, and the Dominican Republic. Flirtey ran the first legal drone delivery for bottled water, food, and a first-aid kit in the United States on July 17, 2015. Amazon received FAA approval for research and development for drone delivery in 2015.
2018	Drone expects to gain widely permitted commercial delivery drones. The FAA estimates that as many as 7,500 commercial drones may obtain drone permits from the FAA by 2018, provided that necessary regulations are in place.

Source: DHL Press Release. (2016). Successful Trial Integration of DHL Parcelcopter into Logistics Chain, http://www.dhl.com/en/press/releases/releases_2016/all/parcel_ecommerce/successful_trial_integration_dhl_parcelcopter_logistics_chain.html (accessed Mar 21, 2017). Bonn.

2.6.1 Amazon Prime Air

On 7 December 2016, Amazon succeeded in shipping parcels to customers in Cambridge, England. The company further called this service “Amazon Prime Air”.

They additionally established a distribution center in Cambridge in order to support an increasing number of customers in the future. They officially posted video clips on YouTube on 14 December 2016 to mark the success in shipping products to customers (Amazon, 2016).

Flashed back to 1 December 2013, the CEO of Amazon.com; Jeff Bezos revealed the plan for “Amazon Prime Air” on the 60-minute interview. He stated that “Amazon Prime Air” would utilize drones for air shipping. In this manner, each package would be delivered directly in front of the customers’ doorsteps within the period of 30 minutes after the order (Hudson, 2014). Moreover, there are several appropriate criteria for the products to be delivered by drones, such as packages lighter than 5 pounds (2.26 kilograms) have to be sufficiently small to be packed into boxes. There has to be a designated shipping location within the radius of 10 miles from the distribution center. Fortunately, 86 percent of packages distributed by Amazon properly conform to this condition in terms of sizes and weights (Wang, 2016).



Figure 2.9 Drones utilized in the shipping trial in the project “Amazon Prime Air”

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

Amazon has tested different models of drones in a great number of countries such the United States, the United Kingdom, Austria, and Israel. Amazon has conducted research and developed real trials in different forms, in order to assure that the rare possibility of accidents or unexpected circumstances for shipping products by drones. As for actual utilization of drones, the specification differs for different government agencies in each zone or country (Amazon, 2016).

The shipping procedure of Amazon Prime Air

- 1) Customers order products through gadgets such as smart phones, tablets, and laptops.



Figure 2.10 Ordering and Shipment via Amazon Prime Air

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 2) The order is sent to the distribution center near the customer. When the Amazon staff receives the order, the product will be moved out of the warehouse.



Figure 2.11 Picking up product from the warehouse

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 3) The product is subsequently packed into a box for further shipping.



Figure 2.12 Packing product into Amazon box

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

เอกสารนี้เป็นเอกสารที่สงวนไว้สำหรับการใช้งานเพื่อการศึกษ³³เท่านั้น ไม่อนุญาตให้นำไปใช้ประโยชน์ด้านการค้า
ไม่ว่ากรณีใดๆ ทั้งสิ้น อีกทั้งห้ามมิให้ดัดแปลงเนื้อหา และต้องอ้างอิงถึงเจ้าของเอกสารทุกครั้งที่มีการนำไปใช้

- 4) The product is transferred on the assembly line to the awaiting drone.



Figure 2.13 Transferring package to drone

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 5) The product is loaded at the bottom of the drone by an automatic system, and in which the drone is input with the coordinate of the shipping destination.

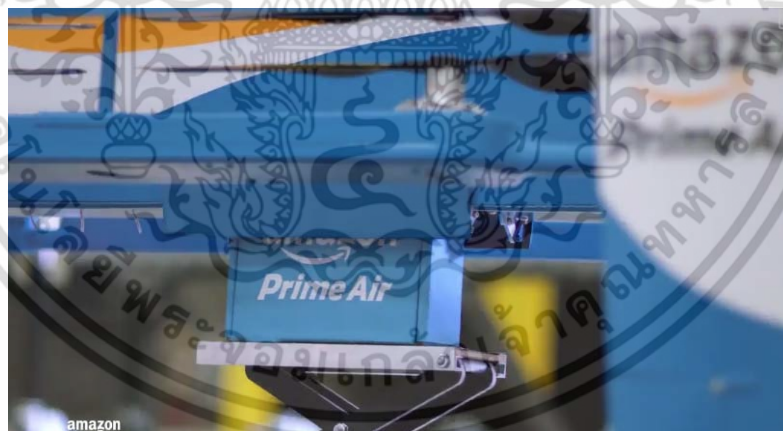


Figure 2.14 Loading packaging to drone

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 6) The drone is released from the distribution center.



Figure 2.15 Flying out of distribution center

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 7) The distribution center is able to perceive the actual vision from the camera attached to the drone with the sensor that detects the speed, the direction, and obstacles.

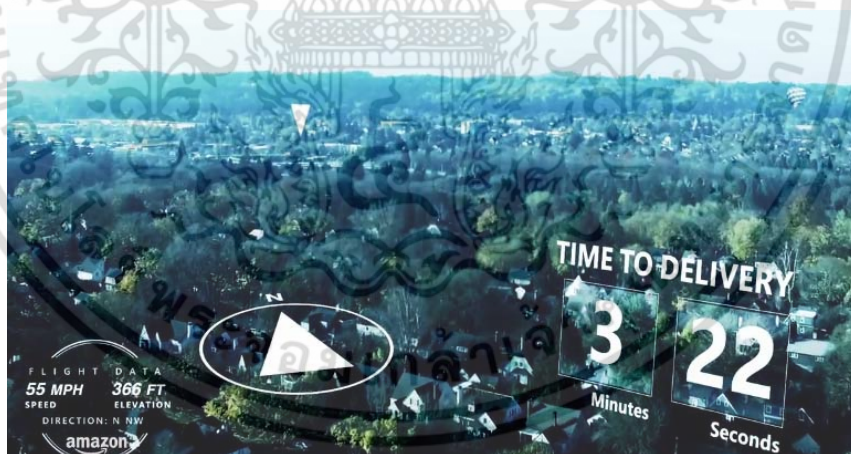


Figure 2.16 Real time visualize surrounding scenario

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 8) The data from the drone is delivered to the customer when it is nearby the destination; the customer is asked for the permission of the appropriate landing location.

เอกสารนี้เป็นเอกสารที่สงวนไว้สำหรับการใช้งานเพื่อการศึกษาระดับ 35 เท่านั้น ไม่อนุญาตให้นำไปใช้ประโยชน์ด้านการค้าไม่ว่ากรณีใดๆ ทั้งสิ้น อีกทั้งห้ามมิให้ดัดแปลงเนื้อหา และต้องอ้างอิงถึงเจ้าของเอกสารทุกครั้งที่มีการนำไปใช้

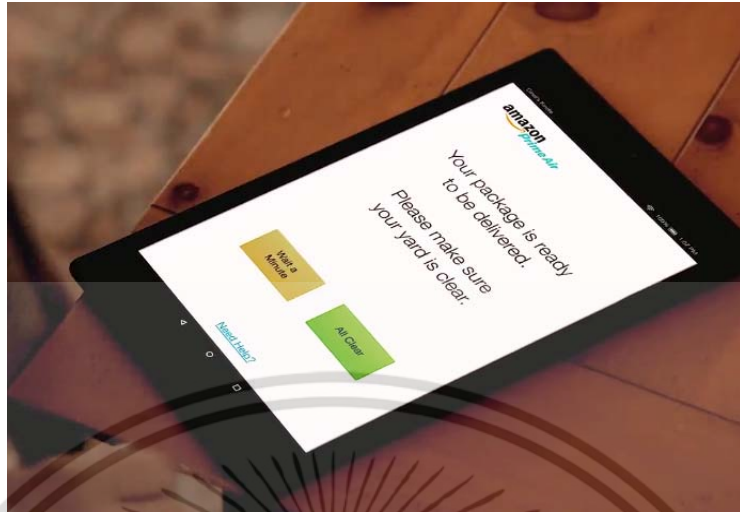


Figure 2.17 Notifying status of delivery

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 9) When the customer informs that he or she is ready, the drone hovers above the designated location.



Figure 2.18 Detecting delivery area

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 10) The drone unloads the product, and travels back to the distribution center.

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Figure 2.19 Dropping product and travelling back

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

- 11) The customer receives the product within 30 minutes of the order.



Figure 2.20 Customer receives package within 30 minutes

Source: Amazon. (2016). Amazon Prime Air. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>

Moreover, Amazon also provides their facilities to support Amazon Web Service (AWS), which empower Amazon’s activities. These include drone service, which is possible to serve their partners to deliver goods to their consumers also (The Economist, 2017).

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2.6.2 7-Eleven

From the two proposed business models, 7-Eleven has displayed a good example of the drone application under the first model. Predominant entities of the retailing industry do not fail to ride along this trend. 7-Eleven has collaborated with a startup company named Flirtey for providing commercial drone services, and in which drones are used as a means for delivering products to customers' residents (Glaser, 2016).

7-Eleven planned to collaborate with Flirtey without having to develop the system on its own. The two companies officially worked together in July 2016 and offered services in November 2016 in the city of Reno, Nevada. In this case, there were 12 exclusive groups of clients who installed a particular application used for ordering products that were delivered by drones as illustrated in Figure 4.22. Relevant information was informed from the loading process to the delivering process. 7-Eleven performed drone deliveries 77 times within one month of the official operation. Additionally, 7-Eleven was able to deliver both cold and hot products in which Flirtey's drones carried the cargo to the customers' residential area and slowly dropped the product while the drone was hovering above. The product was delivered to the customer within 10 minutes (Glaser, 2016).



Figure 2.21 Drone from 7-Eleven deliveries package to their customer

Source: Etherington, D. (2016, Dec 20). 7-Eleven delivers 77 packages via drone in first month of routine service. Retrieved from TechCrunch: <https://techcrunch.com/2016/12/20/7-eleven-delivers-77-packages-via-drone-in-first-month-of-routine-service/>

Although the trial result was satisfactory, 7-Eleven has not yet announced the official delivery service plan. In the future it is inevitable that drones are prone to manifest a significant role in the product delivery. 7-Eleven ought to carefully lay out their business plans since there is a diversity of products in its stocks. Any changes would result in a considerable impact to the company, customers, and competitors. One significant point concerns the official regulations imposed but the government. This may seriously propel any companies to run out of business. Every company should hence be prepared. When the time comes, those who are not prepared might disappear from the market as swiftly as a blink of an eye (Boyle A. , 2016).

2.6.3 DHL

In September 2014 DHL launched a drone delivery service for the first time called “Parcelcopter”, as illustrated in Figure 2.23, to get urgently needed goods such as life-saving medicines to a North Sea island in Germany where more traditional delivery options such as sea and road transports take longer time. Normally the drone was used to deliver either sporting goods or medicines for urgent need. By using normal

car to transport goods, it would take more than 30 minutes during winter to reach Alm station, compare with just eight minutes by using drone to deliver with the same trip (DHL Press Release, 2016).



Figure 2.22 Parcelcopter from DHL

Source: DHL Press Release. (2016). Successful Trial Integration of DHL Parcelcopter into Logistics Chain, http://www.dhl.com/en/press/releases/releases_2016/all/parcel_ecommerce/successful_trial_integration_dhl_parcelcopter_logistics_chain.html (accessed Mar 21, 2017). Bonn.

Parcelcopter flies under 50 meters to avoid entering and interfering regulated air traffic corridor. Although the parcelcopter flies automatically, but it is fully monitored by a DHL station on the German mainland to liaise with air traffic control. This is for safety reasons, and to ensure that the service comply the nation's regulations. Parcelcopter takes a fully automated route to a dedicated landing area and once the parcel arrives safely, a DHL courier will then take over and deliver the parcel to the recipient (Lee, 2016).

Table 2.2 illustrates the evolution of parcelcopter since 2013. Two factors which can take it to logistics market are payload and flight distance. It shows greatly development in distance from 1 kilometer in 2013 to 8.3 kilometer in 2016.

Table 2.2 Evolution milestone of DHL parcelcopter

	Parcelcopter 1.0	Parcelcopter 2.0	Parcelcopter 3.0
Year	2013	2014	2016
Aircraft	Quadrocopter	Quadrocopter	Tiltwing Aircraft
Dimension	1,030 mm	1,030 mm	2,200 mm
Payload	Up to 1.2 kg	Up to 1.2 kg	Up to 2 kg
Airspeed	Approx. 43 km/h	Approx. 43 km/h	Approx. 70 km/h
Control System	Manual	Autonom	Autonom
Flying Area	River crossing	Open sea	Mountainous region
Location	Bonn	Norddeich/Juist	Reit im Winkel/Winklmoosalm
Flight Distance	1 km	12 km	8.3 km
Attitude Difference	none	none	Approx. 500 m

Source: DHL Press Release. (2016). Successful Trial Integration of DHL Parcelcopter into Logistics Chain, http://www.dhl.com/en/press/releases/releases_2016/all/parcel_ecommerce/successful_trial_integration_dhl_parcelcopter_logistics_chain.html (accessed Mar 21, 2017). Bonn.

However, due to the climate in Germany which is sometimes snowy, windy and cold and that is not suitable for flying drones in the sky. DHL admitted that their drone was well suited and worked in areas such as mountain regions in normal weather. Nonetheless, DHL has announced the cancellation of the proposed flight of drone in January 2016 until further development (DHL Press Release, 2016).

CHAPTER 3

METHODOLOGY

This chapter focuses on the procedures and methods of data collection for the analysis of the subjects of interest. The procedures of quality information acquisition included 2 factors: a set of questionnaires and information-providing companies. As Thailand has not used drones in the domain of logistics, the development of questionnaires stems from literature review in Chapter 2; which brings out significant points from each topic, such as business models, laws and regulations, obstacles, and case studies. Another significant point is selection companies for the interview; which is developed from using significant factors in Section 2.6 Case Studies for selecting appropriate companies. Another significant part is the analysis of interview result; in this case, data scoring is used and analyzed accordingly in Chapter 4.

It is evident that the development of questions or criteria are referenced from literature review mostly in Chapter 2. In this regard, the data sources are rather diverse, such journals, articles, researches, and websites. The data in Chapter 2 generates a diversity of perspectives on the application of drones in the business field; most of the perspectives are from businesses conducted abroad. Thailand however has different cultures and geographical features. It is hence interesting to anticipate the kind of the results of data accumulation and analysis that would come into sight.

3.1 Procedures of data collection and analysis

The goal of this study is to conduct surveys on the opportunities and possibilities of using drones in the logistics industry in Thailand. It is essential for data collection

and analysis in diverse dimensions. The main data collected can be used as the guideline in comparison to example companies in Thailand.

The procedures of study are divided into 8 steps:

Step 1 is determining criteria to select appropriate companies in collecting data through case studies from other countries. This method would reveal desirable attributes from companies that are able to practically use drones.

Step 2 is selecting companies that fall into determined criteria.

Step 3 is designing questionnaires for the survey on opinions of the companies in diverse dimensions including business opportunities, obstacles, business impact, and business model.

Step 4 is collecting data from the selected companies.

Step 5 is summarizing data by normalizing it into readable and measurable forms.

Step 6 is scoring and analyzing data company by company and summarizing the overall data.

Step 7 is comparing the data with case studies in Section 2.6, which would reveal congruence or the trends on whether they lean towards the same or different directions; and what are the factors determining such result?

Step 8 is using drone business model in Section 2.3 to analyze the possibility of drone to emerge in Thailand's logistics in term of business aspect

The first and second steps are detailed in Section 3.2. The third step is detailed in Section 3.3. Additionally, the fourth, fifth, sixth, and seventh steps are detailed in Section 4.1 when all the procedures have been completed. The last step is detailed in Section 4.2. This allows us to foresee the opportunities and possibilities of using drones

in the logistics sector in Thailand in the current time, which might face changes subject to future factors.

3.2 Criteria and Target Respondents

The logistics industry in Thailand is massive and constantly growing, in order to support the inauguration of the ASEAN Economic Community. There are hence plentiful business competitions; whether they are Thai companies or Investment companies. And when there are a variety of logistics service providers, there are also various types of services. From the study on the subject of drones, it was found that the application of drones is not simply easy in the context of each company. This is because there are varied limitations from the drone operation system and the companies. Thus, possible limitations should be considered in order to filter eligible companies.

As mentioned in Section 2.3.1, two business models have been created: 1) collaborating with drone service provider companies, and 2) establishing a specialized division of drone delivery in the company. These two models have gained interest from different companies in the United States. In the case of the first model, 7-Eleven collaborated with Flirtey in the service trial for the drone delivery. As for the second model, it was found that Amazon, UPS, and FedEx have established a specialized division that specifically conducts trials of the drone delivery. Such division aims to study, examine, and develop the operation of drones for practical circumstances.

In Thailand, many logistics companies also manifest the potential for the drone delivery. Initially, design criteria according to major conditions from literature review for the selecting eligible companies. The data from these interviews would be accumulated and assessed in order to reach the results indicating the degree of

preparedness for the future of the drone application of this industry. In this case, criteria that are considered include:

- Offer services or have a plan to offer services for express product or parcel delivery.
- Have a group of customers within the 15-kilometer perimeter of the distributing center.
- Have products that do not exceed 2 kilograms of weight.

Subsequently, there are 5 qualified companies discovered from the fixed criteria as illustrated in Table 3.1. The forms of business and services offered by these companies are specified as follows:

Table 3.1 List of interviewed companies

Company	Nationality	Forms of Business	Express Delivery
A	Hong Kong	Logistics/Warehouse	No
B	Swiss	Logistics/Distribution/Warehouse	Yes
C	French	Logistics/Warehouse	No
D	Hong Kong	Logistics (Express delivery)	Yes
E	Chinese	Logistics/Warehouse	Yes

3.3 Questionnaire Development

Preparing questions for interviewing different companies is highly essential as each question represents several indications in different aspects, which are to be used

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for the assessment and comparison of the capacity and preparedness for the application of drone and its appropriate forms for each company.

In this manner, the assessment of questions is categorized into 4 pillars including:

1. The appropriateness of business
 - a) The type of operating business
 - b) Limitations of products and customers
 - c) Desirable traits of services
 - d) Forms and numbers of distributing centers
2. The interest in the application of drones
 - e) Interest in using drones in the future
 - f) Appropriate types of business
 - g) Advantages on using drones
3. Opportunity of drone service in the future
 - h) Future expectations
4. The Obstacles and Problems
 - i) Possible obstacles
 - j) Impacts of the drone application

To create a comprehensive series of questionnaires covering the four topics, it is essential to study Chapter 2 in detail first. In this case, a variety of literature reviews on drones in different aspects have been studied and different factors were witnessed that influence the practical application of drones. These factors are used to form the questionnaires in diverse dimensions, and in which they lead to the conclusion on the possibility of the application of drones in the logistics industry. As presented in Section 2.6, the case studies shows three example companies namely Amazon, 7-Eleven, and DHL. These companies have inaugurated the trials on drone shipping. In this manner,

outstanding points from each company will be used to form the main questionnaires in each aspect:

a) The type of operating business

- What is the main business and service for your company?
- How many groups of customers can be categorized?

b) Limitations of products and customers

- Are there any groups of customers within the perimeter of 15 kilometers?
- How many kinds of products for delivery? And are there any products with the weight exceeding 2 kilograms?

c) Desirable traits of services

- Is the express delivery service provided?

d) Forms and numbers of distributing centers

- How many methods of shipping does the company have? And which is the main method?
- Which method does the distributor use to ship your product? And which is the main method?
- How many delivery points are there?
- What is your method for assembling products?
- How many distributing centers are there? And where are they?

e) Interest in using drones in the future

- Does the company have any plans to improve the shipping process? If yes, how so?
- Has the company discussed on applying drones into its business?

- Has there ever been a study or an assessment of possible impacts following the drone application?
- What do you think of several domestic companies which have begun testing drone delivery?
- Personally thinking, do you think if there is a possibility for the company to use drones in the future?
- If yes, how many years will it take for this to actually take place?

f) Impacts of the drone application

- Supposedly, if drones are used for the company, what do you think would be possible impacts for different aspects?
 - Internal procedures
 - Personnel
 - Responses from customers
 - Competitors
 - Shipping budgets

g) Future expectations

- Do you think if the business sector in Thailand would officially use drones? If yes, when?
- Do you think if drones would cause a change to the logistics industry? If yes, how?
- How do you think the future shipping methods would change?
- What do you think would be the future impacts for companies which do not use drones for shipping products, when others do?

Additionally, as presented in Section 2.4: Related Laws and Regulations and Section 2.5: Obstacles are mentioned, the findings can be used to form the questionnaires that allow us to witness concerns and limitations of companies in the case of using drones in their business contexts.

h) Possible obstacles

- If the law allows logistics business bodies to use drones, do you think this matter would attract companies in using drones to a greater extent?
- What do you think are issues and obstacles in the subject of the drone application?
- Would you like the government to support in this matter?
- What do you think are limitations for the drone application?

Two business models have been created in Section 2.3, which can be illustrated in Section 2.6: Case studies. In this case, Amazon and UPS have developed drones and relevant systems by themselves. Additionally, 7-Eleven has collaborated with Flirtey in providing product shipment by drones. These 2 models propel companies to have clearer perception and options for drone uses.

i) Appropriate types of business

- If there are two modes of the drone application, what would you select?
 - a) Setting up a unit or a division to be specifically responsible for the matter of drones
 - b) A specialized drone services company
- Please explain your reason for the previous question.
- If a drone company would like to ask for your permission for the trial, would you agree to do so? (If yes, why?)

j) Advantages on using drones

- What do you think would be the advantages for the drone application?

After the questionnaires were developed, it is vital that the questionnaires are to be rearranged into 2 categories: questions on the fundamental business of companies, and questions on specific matters of drone uses.

Business background questions

1. What is the main business and service for your company?
2. How many groups of customers can be categorized?
3. Are there any groups of customers within the perimeter of 15 kilometers?
4. How many kinds of products for delivery? And are there any products with the weight exceeding 2 kilograms?
5. How many methods of shipping does the company have? And which is the main method?
6. Is the express delivery service provided?
7. Which method does the distributor use to ship your product? And which is the main method?
8. How many delivery points are there?
9. What is your method for assembling products?
10. How many distributing centers are there? And where are they?
11. Does the company have any plans to improve the shipping process? If yes, how so?

Drone service Questions

12. Has the company discussed on applying drones into its business?

13. Has there ever been a study or an assessment of possible impacts following the drone application?
14. What do you think of several domestic companies, which have begun testing drone delivery?
15. Personally thinking, do you think if there is a possibility for the company to use drones in the future?
16. If yes, how many years will it take for this to actually take place?
17. Supposedly, if drones are used for the company, what do you think would be possible impacts for different aspects?
- Internal procedures
 - Personnel
 - Responses from customers
 - Competitors
 - Shipping budgets
18. Do you think if the business sector in Thailand would officially use drones? If yes, when?
19. Do you think if drones would cause a change to the logistics industry? If yes, how?
20. If the law allows logistics business bodies to use drones, do you think this matter would attract companies in using drones to a greater extent?
21. What do you think are issues and obstacles in the subject of the drone application?
22. Would you like the government to support in this matter?
23. How do you think the future shipping methods would change?

24. What do you think would be the future impacts for companies, which do not use drones for shipping products, when others do?
25. What do you think are limitations for the drone application?
26. If there are two modes of the drone application, what would you select?
 - a. Setting up a unit or a division to be specifically responsible for the matter of drones
 - b. A specialized drone services company
27. Please explain your reason for the previous question.
28. If a drone company would like to ask for your permission for the trial, would you agree to do so? (If yes, why?)
29. What do you think would be the advantages for the drone application?

Data Scoring

All answers were adjusted to facilitate the data scoring. All the questions are categorized into 2 groups: the group that is used for data scoring, which includes 1, 3, 4, 6, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29; and the second group that is not used for data scoring, which includes 2, 5, 7, 9, 10, 21. The data from the second group is, on the other hand, used for further analysis. As for the score, 1 and 0 are only given. Additionally, the scoring criterion is categorized into 2 formats. In the first format, it involves questions requires a yes or no answer; a point is given to the company that answers yes, probably. This also applies to answers that are prone to agree with the question. As for answers namely no and N/A or answer that are prone to disagree with the questions are given a zero point. Moreover, the second format involves the questions that require opinions; in this regard, the questions require opinions, and in which the scoring takes into account contexts of answers in relation to benefits and advantages in comparison to data in the literature review. If the answer is

proved to be beneficial, a point is given; otherwise, no point is given. Finally, the sum of points are calculated into percentage and analyzed for further conclusion.

Validity of Questionnaire

After finished creating questionnaire, it needs to be verified to see its efficiency of categorize companies according to their potentials. As the questionnaires are developed from different sections in Chapter 2, this allows us to recognize appropriate attributes of companies that are able to provide drone services. Since the main goal for the utilization of drones is fast delivery, this allows the addition of the development of criteria to the topic Express Delivery, for the consistency with the study in Section 2.6 Case Studies. Selected companies are categorized into different groups. In this respect, company groups B, D, and E provide express delivery services. Whereas company A and C do not provide such services. These different attributes validate questionnaires on the differences of these companies. The expected result should appear that the first group should have higher scores than the second group. Although this might not be valid to every case, due to other relevant factors; for instance, the future plans of company A and C might be interested in express delivery services, or the drone technology, which might change the expected consequences.

Table 3.2 illustrates details of appointments to interview with representatives of five companies.

Table 4.2 Interview details

Company	Interviewee's Position	Date	Time
A	Assistant General Manager	28 Feb 2017	13:00 – 14:00
B	Client Management Manager	14 March 2017	10:00 – 12:00
C	Business Development Manager	6 March 2017	14:30 – 15:30
D	Head of operations & Service Quality Manager	10 March 2017	15:30 – 16:30
E	Business Development Manager	20 March 2017	11:00 – 12:00

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CHAPTER 4

RESULTS AND DISCUSSION

In this chapter, the data collected from the interviewees is presented. Subsequently, the data is normalized to facilitate result reading and further analysis. Each question in the questionnaires developed in Section 3.3 allows us to survey perspectives of companies regarding drone applications in different dimensions.

4.1 Interview Results

The data accumulation from each company is conducted by interviews, and in which there are 2 methods: the on premise interview and the on-call interview. In this manner, the same set of questions was used and each question is placed in the same order. After the data accumulation from 5 companies was completed, it is essential to adjust the data in a manner that can be further assessed. The questions were categorized into 3 forms: 1. questions requiring a ‘yes’ or ‘no’ answer, 2. questions with multiple choices, and 3. questions with specific purposes. This condition allows the respondents to specify their opinions on the subject without any unnecessary explanations.

Business traits of all companies vary slightly. Because it was intended to acquire diverse perspective. All 5 companies however pass designated criteria. From the first part of data that involves fundamental information of businesses, some differences were spotted. Every company is mainly in the logistics domain; only Company B and D offer express shipment. This is an interesting point because one of the advantages of drones is fast delivery. Types of products distributed by each company also vary. In brief, they can be categorized into several groups including apparel and fashion, cosmetics, FMCG, food & beverage, electronics, retail, chemical, automobile and aerospace parts,

healthcare, equipment and machinery, oil & gas, and plastics. Only Company B and D offer Business to Customer (B2C) services or services that provide direct shipment to customers who are not part of any organizations. Table 4.1 shows data provided by 5 companies. Those data are varied according to their business, service, and customer. Once these differences are analyzed, the results reveal significant factors in identifying appropriate traits for drone applications.



Table 4.1: Interview result

Company A	Company B	Company C	Company D	Company E
1) Business Background Question				
1. What is the main business and service for your company?				
Logistics and Warehouse	Logistics/Distribution/Warehouse (Express delivery)	Logistics and Warehouse	Logistics (Express delivery)	Logistics and Warehouse
2. How many groups of customers can be categorized?				
Automobile Spare parts, Food and plastics	Consumer goods, Healthcare, Personal Care, Equipment and machinery	Aerospace, Cosmetics & Fashion, High Tech, Industries and manufacturing, Distribution and healthcare, Chemical, F&F, Oil & Gas	B2B, B2C and C2C	Footwear & Apparel, FMCG, Food & Beverage, Electronics, Retail, Chemical
3. Are there any groups of customers within the perimeter of 15 kilometers?				
Yes	Yes	Yes	Yes	Yes
4. How many kinds of products for delivery? And are there any products with the weight less than 2 kilograms?				
Deliver products by trucks; most of the products' weight exceeds 2 kilograms.	Yes, there is. Typically, there is a diversity of products in the same truck which is headed to ship products designated to the same direction.	Depends on volume from 4-wheels to 4'ft. Container	Yes, Motorcycle or 4-wheels truck	Depends on volume from 4-wheels to 4'ft. Container

Company A	Company B	Company C	Company D	Company E
5. How many methods of shipping does the company have? And which is the main method?				
Deliver products by trucks	In Bangkok, the pickup trucks with roof panels are used for shipment. If a product is big, a six-wheel drive is used. It is the same case with shipment in the outer parts of the country.	Depends on volume from 4-wheels to 4'ft. Container	In Bangkok mainly motorcycle	Depends on volume from 4-wheels to 4'ft. Container
6. Is the express delivery service provided?				
No	Yes, mostly in medical supplies and healthcare products	No	Yes	No, there isn't. Mostly, customers are from Bangkok, and in which the products are shipped the next day in the case of urgency.
7. Which method does the distributor use to ship your product? And which is the main method?				
The customers deliver the products by trucks.	Trucks; pickup trucks with roof panels	Depends on volume from 4-wheels to 4'ft. Container	No pick up from customers or customers bring to our shop	Trucks; pickup trucks with roof panels
8. How many delivery points are there?				
1	2 – Rama3 and Bangna	2 warehouses	More than 200 shops in Thailand	1
9. What is your method for assembling products?				

Company A	Company B	Company C	Company D	Company E
The trucks are used to receive and deliver products.	Categorize by types of products and routes.	Categorize by types of products.	Categorize by types of products and routes.	Categorize by types of products and routes.
10. How many distributing centers are there? And where are they?				
Rayong	2 – Rama3 and Bangna	NO DC	N/A	Ladkrabang
11. Does the company have any plans to improve the shipping process? If yes, how so?				
In the present, there is none.	There is a plan to increase a number of cars.	No	Yes	Yes
2) Applying drone service to the current business question				
12. Has the company discussed on applying drones into its business?				
No	No	No	Yes	No
13. Has there ever been a study or an assessment of possible impacts following the drone application?				
No	No	No	No	No
14. What do you think of several domestic companies which have begun testing drone delivery?				
It points towards a good direction, but time is essential for further development.	If drones can be successfully used, a turning point in the logistics business is likely to take place.	Some of our companies in other country are testing this method	For Thailand need lots of studies	Possible but not in the near future

Company A	Company B	Company C	Company D	Company E
15. Personally thinking, do you think if there is a possibility for the company to use drones in the future?				
N/A	No	No	Not now	No
16. If yes, how many years will it take for this to actually take place?				
N/A	N/A	No	Not sure	N/A
17. Supposedly, if drones are used for the company, what do you think would be possible impacts for different aspects?				
N/A	N/A	N/A	Competitors and shipping budgets	N/A
18. Do you think if the business sector in Thailand would officially use drones? If yes, when?				
5-10 Years	Probably	Probably in long term	Probably	Probably
19. Do you think if drones would cause a change to the logistics industry? If yes, how?				
Yes, there is; but in a limited circle.	Reduce the human labor.	Probably	Faster Service	Reduce petrol consumption
20. If the law allows logistics business bodies to use drones, do you think this matter would attract companies in using drones to a greater extent?				
Yes	No	No	Yes	Yes
21. What do you think are issues and obstacles in the subject of the drone application?				

Company A	Company B	Company C	Company D	Company E
Cost and necessity	Is there a law regulating this matter? And the cost?	Geography	Geography	Laws in Thailand
22. Would you like the government to support in this matter?				
Yes if the laws facilitate.	No comment	N/A	Laws to support	Laws and Regulations
23. How do you think the future shipping methods would change?				
N/A	Probably	N/A	More routes and more competitors	Yes
24. What do you think would be the future impacts for companies which do not use drones for shipping products, when others do?				
N/A	Probably not	N/A	No	Not much
25. What do you think are limitations for the drone application?				
Cost and Necessity	Laws and Cost	Geography and Laws	Geography and Laws	
26. If there are two modes of the drone application, what would you select? A) Collaborate with drone service company B) Setup a new business unit to take care about drone service				
A	A	A	A	A
27. Please explain your reason for the previous question.				

Company A	Company B	Company C	Company D	Company E
It can facilitate further development and reduce the cost.	Trials can be conducted to determine if it is effective.	N/A	No need to hire employees and invest in drones (cost)	Easy to initiate and low investment
28. If a drone company would like to ask for your permission for the trail, would you agree to do so? (if yes, why?)				
Trials can be conducted to determine if it is effective.	The executive board has to be informed through a meeting on the advantages and disadvantages of using drones.	Probably	Can't decide now, need to study	Probably
29. What do you think would be the advantages for the drone application?				
In the present, there is none.	Not sure	No	Need to study Pros and Cons	N/A

Interview Analysis

As presented in Table 4.1, the data will be transformed into points in accordance with the data scoring criteria in Section 3.3. In addition, Table 4.2 shows data transformed into points of each company in 4 pillars.

From the data in Table 4.2, it was found that the first pillar, the appropriateness of business consists of 10 questions; there are 5 scoring points. The focus point of this series of questions is to examine the degree of appropriateness of each company in the aspect of drone applications. As a result, the sum of points reveals that Company D scored 5 points that are calculated as 100 percent; followed by Company B which scored 4 points, calculated as 80 percent. The rest scored 2 points, equally calculated as 40 percent. In this case, the result indicates that Company A is the most appropriate candidate for drone applications. Placed as second is Company B. The rest three companies, which scored points below 50 percent, deemed as not very appropriate for drone applications for current businesses.

Pillar 2, the Interest in the Application of Drones, involves an important series of questions. This is because it manifests the degree of interest of companies in the applications of drones. From the result of scoring, Company D scored 6 points or 60 percent, which placed it head of other companies; followed by Company E receiving 5 points or 50 percent. The rest scored points below 50 percent. In this respect, this indicates that Company D is interested in the drone application for its business; the points are, however, not considered considerably high. As for the rest of the companies, they show mild interest in drones.

Pillar 3, the Opportunity of Drone Service in the future, involves a series of questions that investigates perspectives of companies on the future of drone applications. It is noticeable that companies with points below 50 percent, which indicates that every company perceives the future

of drone applications in a positive light. Additionally, Company B, D, and E have 70 percent points which are considered quite high. Question 17 asks if drones will be used in Thailand, Company A answered that drones will be used in Thailand for 5-10 years. The rest of the companies answered 'probably'. This indicates a promising future for the drone application in Thailand.

Pillar 4, the Obstacles and Problems, focuses on the subject of limitations and concerns of the companies with the points of 0 and 100 percent in the same category. Noticeably, in the Question 20; although there is a low allowing the application of drones, some companies still perceive that it is unlikely to attract companies to apply drones into their business. This perspective aligns with the Question 22 which touches upon the regions of assistances required from the government; in this regard, the companies that answered 'yes' mentioned the assistance on regulations on drones, which seems to be the major concern of many companies.

Table 4.2 Score result of four pillars data collection

Question	Company A	Company B	Company C	Company D	Company E
1. The appropriateness of business					
a) The type of operating business					
1)	1	1	1	1	1
2)	-	-	-	-	-
b) Limitations of products and customers					
3)	1	1	1	1	1
4)	0	1	0	1	0
c) Desirable traits of services					
6)	0	1	0	1	0
d) Forms and numbers of distributing centers					
5)	-	-	-	-	-
7)	-	-	-	-	-
8)	0	0	0	1	0
9)	-	-	-	-	-
10)	-	-	-	-	-
Sub-Total(1)	2	4	2	5	2
Percentage(1)	40	80	40	100	40

Question	Company A	Company B	Company C	Company D	Company E
2. The interest in the application of drones					
e) Interest in using drones in the future					
11)	0	0	0	1	1
12)	0	0	0	1	0
13)	0	0	0	0	0
14)	1	1	1	1	1
15)	0	0	0	0	0
16)	0	0	0	0	0
f) Appropriate types of business					
26)	1	1	1	1	1
27)	1	1	0	1	1
28)	1	1	1	1	1
g) Advantages on using drones					
29)	0	0	0	0	0
Sub-Total(2)	4	4	3	6	5
Percentage(2)	40	40	30	60	50
3. Opportunity of drone service in the future					
h) Future expectations					
18)	1	1	1	1	1
19)	1	1	1	1	1
23)	0	1	0	1	1
24)	0	0	0	0	0
Sub-Total(3)	2	3	2	3	3
Percentage(3)	50	75	50	75	75
4. The Obstacles and Problems					
i) Possible obstacles					
20)	1	0	0	1	1
21)	-	-	-	-	-
22)	1	0	0	1	1
25)	0	1	0	1	1
j) Impacts of the drone application					
17)	0	0	0	1	0
Sub-Total(4)	2	1	0	4	3
Percentage(4)	50	25	0	100	75
Total	10	12	7	18	13
Percentage	43	52	30	78	57

เอกสารนี้เป็นเอกสารที่สงวนไว้สำหรับการใช้งานเพื่อ **65** ศึกษาเท่านั้น ไม่อนุญาตให้นำไปใช้ประโยชน์ด้านการค้า ไม่ว่าจะกรณีใดๆ ทั้งสิ้น อีกทั้งห้ามมิให้ดัดแปลงเนื้อหา และต้องอ้างอิงถึงเจ้าของเอกสารทุกครั้งที่มีการนำไปใช้

Through the analysis of the total scores, it was found in Table 4.2 that the score in each pillar shows the relation of clearly concordant data. The process begins with questions in the first pillar which is an important starting point that affects the results from other pillars. This is because they are questions revealing business traits appropriate for the drone applications. The companies with the highest point in this pillar are likely to get high points in following pillars. In this case, it is evident that Company D scored 100 percent in first pillar; followed by Company B, which scored 80 percent, and the rest scored 40 percent.

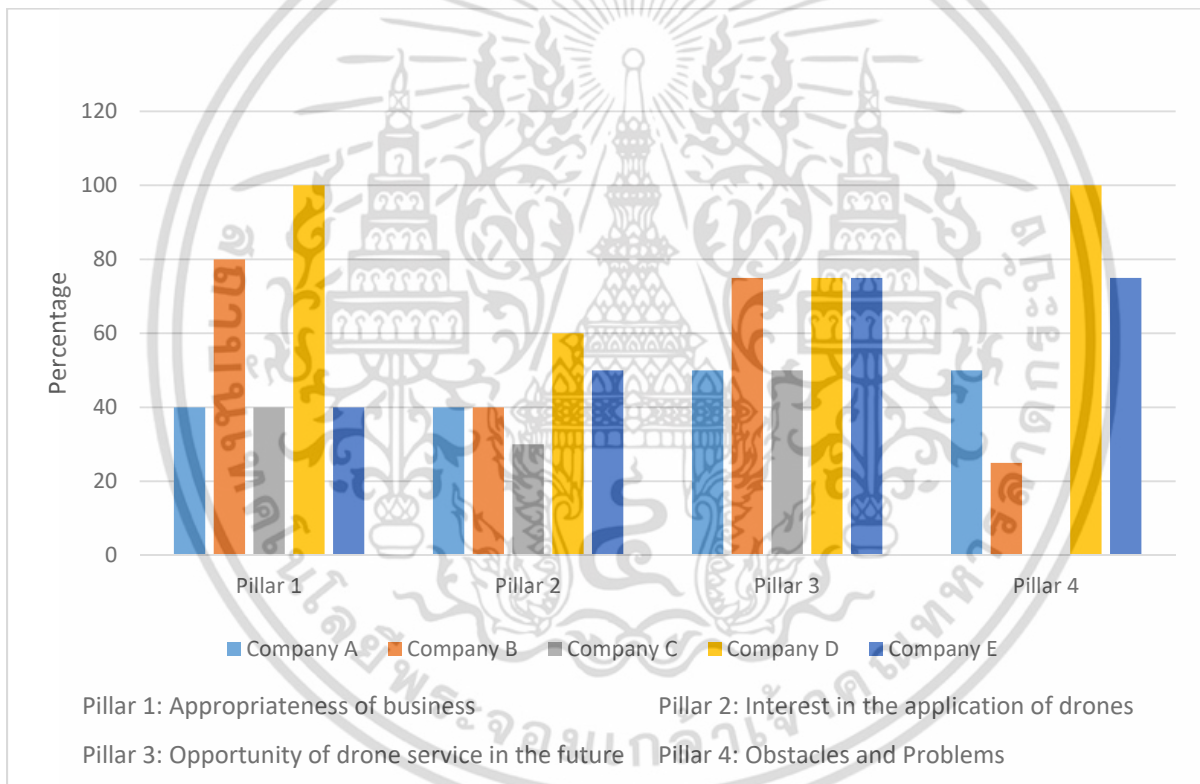


Figure 23.1 Scoring of four pillars data collection in percentage

In Figure 4.1, Company D has the highest score in every pillar, and in Figure 4.2 shows the total points. As expected, Company D had the highest score, which is 78 percent. Noticeably, Company E, which did not score as well as it did in the first pillar, came second with the total score replacing Company B; as Company B only did well in the first pillar, but came behind

Company E in all three pillars. From points scored in all pillars, Company C also indicated how its business is not appropriate to the drone applications. When accumulated all the points, it is not surprising that Company C only scored 30 percent. The difference of the points between Company C and Company D is more than a half; Company D scored 78 percent.

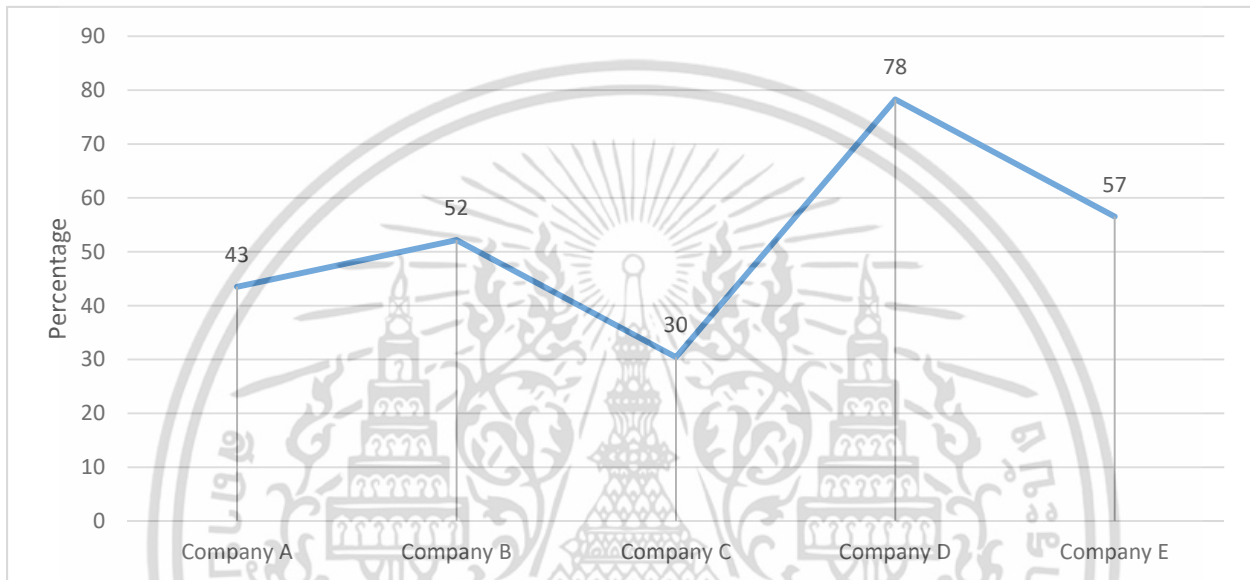


Figure 4.2 Total score of five companies

4.2 Comparing case studies in literature review

As presented in Section 2.6, it was found that there are 3 factors in drone applications by Amazon, 7-Eleven, and DHL. The first factor involves products with the weight exceeding 2 kilograms; if the products with more weights require bigger drones, this is impossible due to the law that limits the total weight of drones. The second factor is that customers are required to deliver products within the perimeter of 15 kilometers. The third factor refers to companies having express deliveries, which means products should be delivered to the customers within 10-30 minutes. If the delivery takes more time, other forms of deliveries can be used as a replacement. This series of questions are in the first pillar: Question 3, 4, and 6. All three answers have been confirmed

with positive responses by Company D, while other companies answered with a few positive responses.

The next significant factor is types of products and numbers of distributing products. For all three companies in the Case Study, there are B2C products or services and a considerable number of distributing centers. This data is from Question 2 and 8, and in which Company D answered that there are B2C products and services. More importantly, Company D has more than 200 distributing centers. For the rest of the companies, there are some B2C services, but there are only a few distributing centers. This further affects the second pillar; answers from Company A, B, C, and D appear to be as expected in which the interest in drones does not exceed 50 percent. This is different from Company D, which has the score of 60 percent in its interest in drones.

The most prominent question is Question 26 related to business model. There are two options: A) the partnership with drone companies or B) establishing the drone department. In this topic, every companies chose the same answer, which is A under different reasons. For example, the partnership can facilitate further the drone development; there is a low amount of budget; and the trials can be conducted. In this vein, it can be analyzed that the companies would like to focus on types of businesses they are familiar with, and outsource irrelevant matters to other companies. Additionally, the budget can also be controlled.

It is interesting that although some companies agree that drones are not added to their plans; if there is a drone services company contacted them for shipping trials, all 5 companies are willing to conduct the trials. This indicates that the turning point of drones in Thailand might be brought about by appropriate forms of businesses. Another turning point is that if there is a company active in the market, especially if the competitor begins to conduct drone trials, all 5 companies are imperative to study the possibilities in the business region, and conduct trials as well. In this case,

the companies are of the opinion that if the government encourages or loosens the laws, this might be the signal of the beginning of the drone application in Thailand.

Another interesting point is how Company D continually scored high points, and Company C closely followed. After the analysis, the answers of the two companies point to reasons supporting the results. This consequently indicates that the development of questions is effective, as they are able to clearly separate a group of companies that have the capacity on different levels. This being the case, if the development of questions has been conducted in a more comprehensive manner, and in which the literature review is referenced to a greater and more diverse extent in the future; companies that are prone to be successful in the practical drone applications might be identified more clearly.

4.3 Potential/Future of Drone for Logistics in Thailand

To discuss upon drones in relation to business in Thailand, it remains a far-fetched possibility, especially in the logistics industry; as other countries are still in the trail process. The main problem hindering the rise of drones could be rooted in limitations in regulations that concern possible negative impact caused by drones. For Thailand, after accumulating and analyzing data in comparison to case studies in the literature review section, it was found that some companies have the potential for future drone applications, and in which there are some significant key factors indicating the appropriateness of the business run by the company.

Apart from the business traits, there is an important factor catalyzing the practical drone application is appropriate forms of business. According with the finding from the analysis in Section 4.1 on the Question 26, there are 2 business forms for the respondents to select: 1) the partnership with the drone services company, and 2) establishing its own drone system. In 2.6, it

was found that Amazon and DHL used the first form, whereas 7-Eleven used the second form; in this respect, it collaborated with Flirtey. After the data accumulation, it was found that the every correspondent selected the second business form.

On this note, it is perceptible that drone service company is a significant factor catalyzing the rise of drone services in Thailand, rather than laws. This is evident from the fact that several companies in other countries began conducting drone trials, despite having legal limitations. It should be additionally noted that the development of drone systems appropriate for any businesses is not simple. Adjusting laws that enable the drone applications also take time. If these two factors can be accomplished simultaneously, companies that have conducted the drone trials might be prepared to offer services in the duration adjacent to when the legal conditions and limitations would have been adjusted. Then, these companies would become the leaders in drone services at once. In this case, newcomers might take some time to get accustomed to the business.

Thailand still lacks drone services companies. It is imperative that companies, which aspire to specifically establish the drone services analyze for advantages and disadvantages in different dimensions. In order to arrive at a better understanding, two business models in three perspectives should be surveyed. One is the perspective of companies that are established to specifically provide drone services. One is the aspect of partner companies who collaborate with drone service company. Additionally, the last perspective focuses on companies that aspire to develop drones on their own accord.

4.4 Business Model Analysis

In the aspect of business-based application of drones, there are diverse factors to be considered for the conciseness and the clarity of the study. The focus is thus on business group namely logistics and distribution, and in which two business models are to be constructed: 1)

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ไม่ว่ากรณีใดๆ ทั้งสิ้น อีกทั้งห้ามมิให้ดัดแปลงเนื้อหา และต้องอ้างอิงถึงเจ้าของเอกสารทุกครั้งที่มีการนำไปใช้

Collaborate with drone service provider companies to support the application of drones in the aspect of shipping, and 2) Arrange a department specifically working on drones. In this case, the business model canvas will be used to help create the two business models with three aspects.

1. Collaborate with drone service provider companies

The first model is to consider to collaborate with drone service provider companies, which is expected to contribute to the development of the drone services in a rapid manner. This model is quite new and may take time to happen in Thailand, but there are many strong points worth to explore. There are however some ramifications to be considered as well. In this case, the SWOT analysis will be used to analyze this business model.

The SWOT Analysis

These 2 types of companies should be analyzed to explore in various aspects 1) a drone service provider company 2) a company to collaborate with drone service company or client company.

Strengths

1) For drone service provider company

- It has an ability to accumulate different types of resources to develop the systems of drones, including both hardware and software, to be more efficient.
- It has an ability to create departments working on different subjects in order to cover overarching spheres such as service & support, sale, call center, marketing, finance, R&D, and laws.
- The service budget is cheaper since it is conducted in a shared resources manner instead of a dedicated resources manner.

2) For client company

- Focus on main business and let expertise help to enhance service level to satisfy customer needs.
- Easy to manage cost, as price scheme can be negotiated from drone service provider companies and offer attractive packages to customer.

Weaknesses

1) For drone service provider company

- Initially, there might not be a large number of customers to cover for the expenditure of the company. It is thus essential to build the substantial customer base in a certain period of time as determined by the company.
- As it is a relatively new form of technology, new kinds of issues might not be managed swiftly, and consequently affects the image of the company. In this case, the company should recruit experienced personnel and train responsible teams to be prepared for the possible issues.
- The shipping distance should not exceed 15 kilometers; from the distributing enter to the destination.

2) For client company

- There will be a lot of adjustments to redesign in work flow to delivery product to customer.
- At the beginning, there are not many drone service provider companies, which can make them more advantage to negotiate for the price and other agreements.

Opportunities

1) For drone service provider company

- There is a high possibility for the drone services company to advance as the leader for agencies and companies.
- Entering the market during the initial wave generates quick awareness.

2) For client company

- Penetrate to the new paradigm faster and gain more market share for a new logistics channel.

Threats

1) For drone service provider company

- The preparedness of the personnel in this field is still insubstantial. It might take some time to cultivate it.
- It is necessary to study the laws for overarching business services and the following issues, in case undesirable circumstances are to take place.
- Competition from other companies is prone to occur. If it is from a company which manifests an expertise in this field, the new company will greatly be at disadvantages.

2) For client company

- A drone service company can offer the same service to other logistics companies which is finally this new service will make no different as every players play the same game.

- With new technology, anything can happen, and it may cause the complaint from customer.

Business model canvas will focus on a drone company model only. Since the client company is similar to a setting up drone division model will be explored in next part.

Business Model Canvas – For drone service provider company

- Customer Segment – Initially, the focus is on the aspects of logistics and retails. Other aspects are to be further explored. All of which have the ability to apply drones into practice such as live broadcasts, events, performances, estate groups, and governmental agencies and other organizations such as the police agencies, the Royal Forest Department, and the Meteorological Department; the latter is of special interest.
- Value Propositions – One of the distinctive attributes of drones is a relatively low amount of cost, which further lessens the organizational budget. More importantly, convenience and speediness are key factors in shipping for the vacant air distance under 200 meters. In this regard, using drones for shipping is as swift as driving on an empty road with no traffic lights. It is also cheaper than shipping by automobiles.
- Channels – There are two types of sales channels:
 1. The sales department contacts customers directly to conduct contracts for consecutive services. For instance, the customers are those working in the field of logistics or retails.
 2. A service can be made one by one, and in which the service fee is calculated each time. The customers are either able to contact the company directly or on line.

- Customer Relationships – For customers from organizations, there is a sales team providing services for them. As for the first-time customers, there is a call-center team in charge of calling customers on their satisfaction of services. Websites, Facebook, and Twitter are also established to build a trustworthy relationship with the customers in a consistent manner.
- Revenue Streams – There are two types of incomes as mentioned in the Channels section:
 1. For long-term customers, a 3-year service contract is to be made. They are additionally granted with a privilege of inserting brands for the advertisement on drones.
 2. For general customers, there are different kinds of packages for the customers' diverse preferences including packages that are valid for different times of usage such as the one-time package, the 10 time-per-month package, the unlimited-in-a-year package, or the 50-time-per-month package.
- Key Resource – The main resource is personnel in the service system development team. In this case, it would be good to collaborate with top-notch universities to conduct further study and develop drone services consistently.
- Key Activities – The customers are to be given shipping services or product transferring services by drones, which are monitored by the central office. The customers are subsequently informed about the status of products through real time tracking.

- Key Partners – There are different type of partners. As for the drones, suppliers are to develop drones specifically for shipping. In terms of the development department, it would be good to collaborate with top-notch universities. In terms of on-line advertisement, Google, Facebook, and YouTube
- Cost Structure – The cost of the software development used to control and monitor drones; the cost of the development of appropriate use of drones for shipping; the cost of marketing; the cost of office rental; employees’ salaries

2. Setting up a drone division in the company

This model will focus on setting up a new division responsible for providing drone services for each organization. To illustrate further, Amazon in the United States has established “Amazon Prime Air” specifically to manage drone delivery. This model is to be analyzed in different dimensions:

The SWOT Analysis

Strengths

- There are tasks for the trials and actual use of drones.
- Internal Resources of organizations can be used to develop a drone division effectively.

Weaknesses

- As it is simply a division in the organization, the resources that are allocated for this division might not be at the maximum.
- The shipping distance should not exceed 15 kilometers; from the distributing enter to the destination.

- The establishment of the drone division might affect some of the employees directly in a long term. They might develop a sense of insecurity in terms of working.
- As it is a relatively new form of technology, new kinds of issues might not be managed swiftly, and consequently affects the image of the company.

Opportunities

- Entering the market during the initial wave generates quick awareness.
- If drones can be used in a practical manner, it would lessen the budget and increase the shipping speed.

Threats

- The preparedness of the personnel in this field is still insubstantial. It might take some time to cultivate it.
- It is necessary to study the laws for overarching business services and the following issues, in case undesirable circumstances are to take place.

Business Model Canvas

- Customer Segment – Provide services to the same customers by replacing shipping by automobiles, with the condition that the shipping distance should not exceed 15 kilometers; from the distributing enter to the destination.
- Value Propositions – Speediness and punctuality; the customers are allowed to determine the arrival time of the shipping
- Channels – There are 2 types of sale channels:

1. Through the same department which had previously contacted the customers, by additionally presenting the drone delivery to the customers.
 2. Providing online services in which customers are allowed to select the service of their preferences.
- Customer Relationships – For customers from organizations, there is a sales team providing services for them. As for the first-time customers, there is a call-center team in charge of calling customers on their satisfaction of services. Websites, Facebook, and Twitter are also established to build a trustworthy relationship with the customers in a consistent manner.
 - Revenue Streams – There are two types of incomes as mentioned in the Channels section:
 1. For long-term customers, a 3-year service contract is to be made. They are additionally granted with a privilege of inserting brands for the advertisement on drones.
 2. For general customers, there are different kinds of packages for the customers' diverse preferences including packages that are valid for different times of usage such as the one-time package, the 10 time-per-month package, the unlimited-in-a-year package, or the 50-time-per-month package.
 - Key Resource – The main resource is the team and the trustworthy shipping system that earns the customers' trust continuously; further business will expose customers to a new experience of drone delivery.

- Key Activities – Customers are granted with shipping or product transferring by automobiles or drones, which enhances the efficiency of shipping in accordance with the customers’ needs.
- Key Partners – Our partners for the drone division are drone manufacturers and drone control software development companies
- Cost Structure – The main cost covers drone equipment, the development of software used to control and monitor drones, the development of appropriate use of drones for shipping. If there is a need for more automatic systems, there is hence the cost of the development of the assembly line used to transfer products to drones before shipping.

Table 4.3 illustrates summarization of data from SWOT result, which consists of two models. Both models have different advantages and disadvantages. Model 1 can be more beneficial to logistics company in terms of low budget and ease of launching service.

Table 4.3 Summarizing SWOT result

	Model 1		Model 2
	Drone service company	Client company	Drone division
Strengths	<ul style="list-style-type: none"> - Specialize in drone, more resources, more efficient. - Service cost is lower since the resources are on sharing basis. 	<ul style="list-style-type: none"> - Focus on main business. - Easy to manage cost. 	<ul style="list-style-type: none"> - Utilize internal resources to develop a drone division. - Able to test with current customer.

<p>Weaknesses</p>	<ul style="list-style-type: none"> - Inadequate profit to cover for the expenditure of the company. - The shipping distance should not exceed 15 kilometers. 	<ul style="list-style-type: none"> - There will be a lot of adjustments to redesign in work flow to delivery product to customer. - Less drone service companies can make them more advantage to negotiate for the price and other agreements. 	<ul style="list-style-type: none"> - Only a division, this might not be at the maximum efficiency. - This division might affect some of the employees directly in a long term. - New kinds of issues might not be managed swiftly, and consequently affects the image of the company. - The shipping distance should not exceed 15 kilometers.
<p>Opportunities</p>	<ul style="list-style-type: none"> - There is a high possibility for the drone services company to advance as the leader for agencies and companies. - Entering the market during the initial wave generates quick awareness 	<ul style="list-style-type: none"> - Penetrate to the new paradigm faster and gain more market share for a new logistics channel. 	<ul style="list-style-type: none"> - Entering the market during the initial wave generates quick awareness. - It would lessen the cost and increase the shipping speed.

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Threats	<ul style="list-style-type: none"> - Lack of experience staff to manage this project - It is necessary to study the laws for overarching business services and the following issues, in case undesirable circumstances are to take place. - Competition from other companies is prone to occur. 	<ul style="list-style-type: none"> - A drone service company can offer the same service to other logistics companies which is finally this new service will make no different as every players play the same game. - With new technology, anything can happen, and it may cause the complaint from customer. 	<ul style="list-style-type: none"> - Lack of experience staff to manage this project - It is necessary to study the laws for overarching business services and the following issues, in case undesirable circumstances are to take place
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4.5 Requirements to setup drone service

In the aspect of the development of drones, there required partners from a variety of sectors which contribute to the success of this project. From the two business models: 1) Collaborate with a drone services provider company and 2) Setting up a drone division in the established company; mainly, the process of fining partners is similar for both models. Hence, following is the exploring of requirements needed to establish from the foundation and find partners in almost every step.

Finance – The financial support is the heart of this model. This project can be presented as a form of the startup company in order to accumulate funding from different venture capitals including the support from governmental agencies.

Hardware – Collaborate with top-notch drone companies such as DJI, in order to find the proper model for shipping and other aspects of use.

Software – Collaborate with software house companies, in order to accumulate funding and monitor drones.

R&D – Collaborate with top-notch universities to develop drones in the aspect of hardware and software. This includes recruiting capable university students who would strengthen the team

Marketing – Collaborate with Google, Facebook, Twitter and YouTube to raise an awareness of drone application in the target groups.

Regulation – There is a need for partners who work on laws and regulations for the proper and accurate use of drones.

Web payment – As for online services, the customers are able to make payments immediately. In this case, the payment gateway is to be established, and in which any general banks can be selected for this.

Call center – The call center outsource can provide services for information inquiries, complaints, and satisfaction surveys.

In this topic, it can be concluded that business model is one of the key factor which enhance the possibility of drone applications in the logistics business in Thailand. A drone service company is the important factor to catalyze the next step of drone delivery. This reality might not take a long period of time as previously expected. This is because, in the present, technology of drone has been continuously developed in a rapid manner and the idea of using drone to transport product or passenger has been tested in many countries. This can be a big trend of innovative

delivery in the future. For those who took a slow step, and fail to catch up with the global changes; their businesses are prone to face impacts or cease operation. Drones are not simply gadgets that are to grow out of the trend. They are, on the other hand, used in a variety of activities. It is thus certain that drones are as significant entity that is able to certainly alter service forms in the logistics business altogether.



CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Different types of technology in the current era have been developed in a rapid manner that a considerable number of companies are not able to concurrently adjust themselves to this reality. Drones are one of the interesting technologies, which have been continuously developed initially from military uses to personal activities. In terms of business sector, there is a growing trend of drone applications in bird's eye-view live, or remote area survey. Although drones are used in a variety of applications, they are not greatly widespread, especially in logistics business. In this respect, other countries are still in the trial stage, and in which drones have not been used in a serious manner. The main reason could be from the regulatory limitations and the novelty of technology, which only allows top-notch corporates to have confidence in the development of drones as one of the options for express delivery.

5.1 Conclusion

This study aims at the perspectives of Thai logistics business on the drone technology. The study of logistics drones in different dimensions has been conducted. Initially, the study began with literature reviews, which were further developed into appropriate questions. Subsequently, the data was accumulated from eligible companies and analyzed. Furthermore, the survey on different business models appropriate for drone applications was conducted. In **Section 4.1**, the data analysis, it was found that there are some companies, which have the potential for future drone applications. Additionally, the main factor to increase the opportunities for drone applications in the logistics business in Thailand is the appropriate business models. In Section 4.4, it was found

that the emergence of drone service company will be the best option for logistics companies to start this innovative service.

5.2 Recommendation for Logistics Industry

Many companies perceive that drones are a new entity for the logistics business, and express their indifference in this new innovation. It is nonetheless a high stake to ignore and turn away from this technology. Many companies are international companies, which are at the advantage since the headquarters might be in the process of conducting research or trials. Once the drone development is completed, the branch companies in every country might gain benefits alongside the headquarters as well. This is different from local logistics companies in Thailand, which are likely to be fully faced with following impacts, as each change requires a large amount of resources. It is possible that once drones have been developed with more competencies, and top-notch companies are able to fully use them in operation; small companies in Thailand or in other countries, which are not able to use drones might go out of business or cease the operation from the logistics business.

Another option for express delivery, which can compete with drone is GrabBike service. This service has many similar benefits with drone or even better in some aspects. Unlike drone, GrabBike is the ready service with less limitation about laws and regulations. People can simply download GrabBike application from their mobile phone and the service is ready for everyone. The main disadvantage for this service is the price. GrabBike is not an economy option for delivery. People like this service because it can penetrate through the heavy traffic, which can shorten delivery time. Another concern is reliability because GrabBike is not the employer of rider, it plays a role of a facilitator for rider and customer. Each rider may behave differently and can

affect to delivery. Moreover, people may concern about the security of package. If a problem were to occur, GrabBike could not take any responsibilities. This is perhaps one of the causes maintaining its low-key popularity among product distributors.

5.3 Recommendation for future studies

It should be noted that the findings of this study is simply the beginning. Once the factors change and new studies are conducted, new findings may be different from the previous ones. This study will be thus worthwhile as it paves ways for the improvement of the preparedness of the formal drone applications in the logistics industry in Thailand. Specifically, Thai logistics companies should conduct possible impacts from the imminent formal approval of drone applications in this field of business. Otherwise, more prepared companies might take all the benefits. For instance, if 7-Eleven created drone shipment, the possible impact could be extensive. In this vein, a large number of businesses should be affected. This also applies to the mass transportation system in the sense that there is a possibility of UBER using the drone taxi; in this case, the question is which business would be affected? Similarly, there is another possibility of drones being developed to the extent that they are able to carry heavy products and ship products within a wide perimeter; which is not a far-fetched reality since military drones care able to carry heavy rockets and fly in a long distance. This indicates that there is the existing technology. It only lacks the appropriate development for business purposes. These matters should be formally studied, and possible solutions should be sought after. Businesses that are prone to be affected from this change should be prepared to adjust themselves. Otherwise, many Thai companies might cease to exist or be taken over eventually.

REFERENCES

- Ackerman, S. (2011). *Pentagon: Drones Can Stop the Next Darfur*. Retrieved from <https://www.wired.com/2011/02/drones-vs-darfur/>
- AirVid. (2014, Sep 2). *20 great UAV applications areas for Drones*. Retrieved from AirVid: <https://air-vid.com/20-great-uav-applications-areas-drones/>
- Alexandre Joyce, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. *Journal of Cleaner Production*, 1474-1486.
- Amazon. (2016). *Amazon Prime Air*. Retrieved from Amazon: <https://www.amazon.com/Amazon-Prime-Air/b?node=8037720011>
- Arifwidodoa, S. D., & Tanaka, T. (2015). The Characteristics of Urban Heat Island in Bangkok, Thailand. *Procedia - Social and Behavioral Sciences*, 423 – 428.
- Arnett, G. (2015, Mar 16). *The numbers behind the worldwide trade in drones*. Retrieved from The Guardian: <https://www.theguardian.com/news/datablog/2015/mar/16/numbers-behind-worldwide-trade-in-drones-uk-israel>
- BBC News. (2012, Jan 31). *Drones: What are they and how do they work?* Retrieved from BBC News: <http://www.bbc.com/news/world-south-asia-10713898>
- Berry, T. (2017). *What Is a SWOT Analysis?* Retrieved from <http://articles.bplans.com/how-to-perform-swot-analysis/>
- Bin Fang, Q. Y. (2016). Effect of sharing economy on tourism industry employment. *Annals of Tourism Research* 57 , 234–278.
- Bitzinger, R. A., & Leah, C. M. (2016, Oct 13). *Nuclear-Armed Drones? They May be Closer Than You Think*. Retrieved from The National Interest: <http://nationalinterest.org/blog/the-buzz/nuclear-armed-drones-they-may-be-closer-you-think-18034>
- Blackhurst, R. (2012, Sep 24). *The air force men who fly drones in Afghanistan by remote control*. Retrieved from The Telegraph: <http://www.telegraph.co.uk/news/uknews/defence/9552547/The-air-force-men-who-fly-drones-in-Afghanistan-by-remote-control.html>
- Boonyarat Phadermrod, R. M. (2017). Importance-Performance Analysis based SWOT analysis. *International Journal of Information Management*.
- Boyle, A. (2016, Dec 20). *Flirtey says its drones are making routine deliveries for 7-Eleven in Nevada*. Retrieved from GeekWire: <http://www.geekwire.com/2016/flirtey-drones-7-eleven-reno-nevada/>
- Boyle, M. J. (2014). The Race for Drones. *Foreign Policy Research Institute*, 76-94.

- Bristeau, P.-J., Callou, F., Vissière, D., & Petit, N. (2011). The Navigation and Control technology inside the AR.Drone micro UAV. *IFAC Proceedings Volumes*, 1477-1484.
- Brooks, M. (2012). The drone age. *New Scientist*, 42-45.
- Bumiller E, S. T. (2011, June 19). *War Evolves With Drones, Some Tiny*. Retrieved from The New York Times:
http://agriculturedefensecoalition.org/sites/default/files/file/constitution_1/1W_2011_War_Evolves_With_Drones_Some_Tiny_as_Bugs_for_Spying_Other_Purposes_U.S._Air_Force_NYTimes_June_19_2011_Entire_Article.pdf
- CAAT. (2015, July 2). *On Rules to Apply for Permission and Conditions to Control and Launch Unmanned Aircraft in the Category of Remotely Piloted Aircraft*. Retrieved from The Civil Aviation Authority Of Thailand: <https://www.caat.or.th/wp-content/uploads/2017/03/Drone-Regulation-Eng-Translation.pdf>
- Clarke, R. (2014). Understanding the drone epidemic. *Computer Law & Security Review*, 230-246.
- Cle-Anne Gabriel, J. K. (2016). Business models for model businesses: Lessons from renewable energy entrepreneurs in developing countries. *Energy Policy*, 336–349.
- Colomina, P. M. (2014). Unmanned aerial systems for photogrammetry and remote sensing: A review. *ISPRS Journal of Photogrammetry and Remote Sensing* 92, 79-97.
- Dhiraj, D. A. (2015, Mar 16). *Global Drone Trade: World's Largest Importing And Exporting Countries*. Retrieved from <http://ceoworld.biz/2015/03/16/global-drone-trade-worlds-largest-importing-and-exporting-countries/>
- DHL Press Release. (2016). *Successful Trial Integration of DHL Parcelcopter into Logistics Chain*,
http://www.dhl.com/en/press/releases/releases_2016/all/parcel_ecommerce/successful_trial_integration_dhl_parcelcopter_logistics_chain.html (accessed Mar 21, 2017). Bonn.
- Etherington, D. (2016, Dec 20). *7-Eleven delivers 77 packages via drone in first month of routine service*. Retrieved from TechCrunch: <https://techcrunch.com/2016/12/20/7-eleven-delivers-77-packages-via-drone-in-first-month-of-routine-service/>
- FERNQUEST, J. (2015, Jan 20). *Bangkok's ugly wires may go underground (photos)*. Retrieved from <http://www.bangkokpost.com/learning/learning-news/458418/bangkok-ugly-wires-may-go-underground-photos>
- Fortune Tech. (2016). *All of These Countries Now Have Armed Drones*. Retrieved from <http://fortune.com/2016/02/12/these-countries-have-armed-drones/>
- French, S. (2016, Dec 14). *Amazon's first Prime Air delivery is just more drone hype*. Retrieved from <http://www.marketwatch.com/story/the-heavy-on-hype-light-on-substance-world-of-drone-delivery-2016-12-01>

- G. Houben, K. L. (1999). A knowledge-based SWOT-analysis system as an instrument for strategic planning in small and medium sized enterprises. *Decision Support Systems*, 125–135.
- Gabriel G. De la Torre, M. A. (2016). Workload perception in drone flight training simulators. *Computers in Human Behavior*, 449-454.
- GAO. (2012). *Agencies Could Improve Information Sharing and End-Use Monitoring on Unmanned Aerial Vehicle Exports*.
- Glaser, A. (2016, Dec 20). *7-Eleven beats Google and Amazon to the first regular commercial drone delivery service in the U.S.* Retrieved from <http://www.recode.net/2016/12/20/14026396/7-eleven-drone-delivery-flirtey-first-retail-us-reno-nevada>
- Harriman, L., & Muhlhausen, J. (2013). A new eye in the sky: Eco-drones. *Environmental Development*, 155–164.
- Holden, M. (2016, Nov 17). *Pizza drones will have their work cut out in Melbourne.* Retrieved from The Sydney Morning Herald: <http://www.smh.com.au/comment/pizza-drones-will-have-their-work-cut-out-in-melbourne-20161117-gsr9c3.html>
- Hudson, H. (2014). Enter the drone zones. *New Scientist*, 19-20.
- Jones, C., & Topfer, E. (2014). *EURODRONES Inc.* Retrieved from <http://www.statewatch.org/news/2014/feb/sw-tni-eurodrones-inc-feb-2014.pdf>
- Lee, H. L. (2016). *TECHNOLOGICAL DISRUPTION AND INNOVATION IN LAST-MILE DELIVERY*. White Paper, Stanford Business Graduate School.
- Lowbridge, C. (2015, Oct 5). *Are drones dangerous or harmless fun?* Retrieved from BBC News: <http://www.bbc.com/news/uk-england-34269585>
- Marks, P. (2012). Drones for all. *NewScientist*, 20-21.
- Martin, C. J. (2016). The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalish? *Ecological Economics*, 149-159.
- McCarthy, N. (2015, Mar 18). *The Countries Importing The Most Drones.* Retrieved from <https://www.forbes.com/sites/niallmccarthy/2015/03/18/the-countries-importing-the-most-drones-infographic/#c2314568c3de>
- McFarland, M. (2016, June 7). *Why America's drone problem may not be as bad as some think.* Retrieved from <https://www.washingtonpost.com/news/innovations/wp/2016/06/07/why-americas-drone-problem-may-not-be-as-bad-as-everyone-thinks/>
- McGowan, K. (2015, Dec 23). *'THE STAR WARS EFFECT' LEADS 80'S CLASSIC TOY REVIVAL.* Retrieved from Belfastvibe: <http://www.belfastvibe.com/life/gadgets/the-star-wars-effect-leads-80s-classic-toy-revival/>

- Milmo, C. (2015, Sep 16). *Drones operated by criminal gangs used to deliver drugs mobile phones and potentially firearms to prisoners, admit senior officials*. Retrieved from Independent: <http://www.independent.co.uk/news/uk/crime/drones-operated-by-criminal-gangs-used-to-deliver-drugs-mobile-phones-and-potentially-firearms-to-10504154.html>
- Murray, C. C., & Chu, A. G. (2015). The flying sidekick traveling salesman problem: Optimization of drone-assisted parcel delivery. *Transportation Research Part C*, 86-109.
- Nagpal, K. (2016). *Unmanned Aerial Vehicals (UAV) Market*. Retrieved from <http://www.defproac.com/?p=2041>
- New Scientist. (2016). What is Uber? *New Scientist*, 6.
- Phillips, J. (2016, Jan 6). *The Ehang 184 is a single-passenger drone that transports people (yes, people) at 11,000 feet*. Retrieved from PC World: <http://www.peworld.com/article/3019704/consumer-electronics/the-ehang-184-is-a-single-passenger-drone-that-transport-people-yes-people-at-11-000-feet.html>
- Rao, B., Gopi, A. G., & Maione, R. (2016). The societal impact of commercial drones. *Technology in Society*, 83-90.
- Rocci Luppigini, A. S. (2016). A technoethical review of commercial drone use in the context of governance, ethics, and privacy. *Technology in Society*, 109-119.
- Rundle, M. (2016, Jan 6). *The Ehang 184 is a self-piloting drone you can ride inside*. Retrieved from <http://www.wired.co.uk/article/ehang-184-personal-drone-car>
- Shedlock, M. (2016). *Drone Delivery Wars: Delivery by Drone in US, 7-Eleven Leap-Frogs Amazon; France First at Federal Delivery*. Retrieved from MishTalk: <https://mishtalk.com/2016/12/20/drone-delivery-wars-delivery-by-drone-in-us-7-eleven-leap-frogs-amazon-france-first-at-federal-delivery/>
- Sintusingha, S. (2006). Sustainability and urban sprawl: Alternative scenarios for a Bangkok superblock. *URBAN DESIGN International*, 151-172.
- Storyhunter. (2016, Oct 13). *Storyhunter Guide to Commercial Drone Regulations Around the World*. Retrieved from <https://blog.storyhunter.com/storyhunter-guide-to-commercial-drone-regulations-around-the-world-5795c31165d9>
- The Drone Code*. (2016). Retrieved from <http://dronesafe.uk/wp-content/uploads/2016/11/Dronecode.pdf>
- The Economist. (2015, Dec 29). *Suddenly, there are drones everywhere*. Retrieved from The Economist: <http://www.economist.com/news/science-and-technology/21684685-and-pilots-are-reporting-ever-more-close-encounters-them-suddenly-there-are>
- The Economist. (2017, Mar 25). *Amazon, the world's most remarkable firm, is just getting started*. Retrieved from The Economist:

<http://www.economist.com/news/leaders/21719487-amazon-has-potential-meet-expectations-investors-success-will-bring-big>

Vaszary, Z. (2016). *EHang 184 is a Manned UAV You Will Never Get to Fly*. Retrieved from Dronthusiast: <http://www.dronethusiast.com/ehang-184-is-a-manned-uav-you-will-never-get-to-fly/>

Volovelsky, U. (2014). Civilian uses of unmanned aerial vehicles and the threat to the right to privacy. *Computer Law & Security Review*, (30) 306-320.

Wang, D. (2016). *The economics of drone delivery*. IEEE Spectrum. (5 Jan) <http://spectrum.ieee.org/automaton/robotics/drones/the-economics-of-drone-delivery>.

Wolf, R., & Delet, B. T. (2016, Feb 8). *The aerial data revolution is approaching*. Retrieved from <http://www.businessinsider.com/the-drone-industry-will-change-the-way-we-do-business-2016-2>

Youngchoay, V. (2010). *Civil and Commercial Laws*. Retrieved from https://thai-civil-code.blogspot.com/2010/03/blog-post_598.html