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THE DRONE TECHNOLOGY DEVELOPMENT FOR SUSTAINABLE LOGISTIC ENVIRONMENT

[1]Wynd Rizaldy, [2]Sandriana Marina, [3]Lira Agusinta
[1,2,3]Institut Transportasi dan Logitik Trisakti
wyndrizaldy@gmail.com

Abstract

During the Covid-19 Pandemic, there were obstacles in the distribution of logistics both directly to the affected areas and the risk of contamination by logistics delivery officers when delivering goods, including observing areas that needed development and protection. The purpose of this paper is to describe the drone technology development in Indonesia and the stakeholders involved in utilizing drones as a tool that can assist in logistics distribution as well as assist in observing disaster-affected areas and other business industry. The method used in this research is descriptive qualitative and quantitative, findings it was obtained that drone technology has developed sufficiently supported by national and international regulations so that stakeholders need to anticipate in implementing its use so that there are no negative impacts due to misapplication. The limitation of this research is access to obtain more data so that it can be more detailed in the presentation. As a result, this drone development technology is quite useful, especially in logistics distribution and other uses if it is managed properly according to applicable rules and is one of the solutions that can be taken in certain emergency conditions where the physical approach of the officer is not possible to the impact area.

Keywords: *Drone, Technology, Logistic, Distribution, Impact environment*

Introduction

The relevant research background of the study, As we know that drones are no longer just a defense need but drones can be used depending on personal needs. Even the development of the drone business in Indonesia itself has had transaction growth which has continued to increase since 2015 and predictions in 2017 will continue to increase according to CMO (Credit Marketing Officer) Wearinasia Andrew Gunawan in the future drones will not only be used for the entertainment industry, but for other purposes that are more technical, for example drones for electrical installations to drones equipped with tear gas, drones as human transportation in the future, drones as online delivery carriers, drones as competitions. The potential is one of them which is large and the need to utilize drones also continues to increase. Seeing the potential for drone development in Indonesia, it has great potential and has produced many achievements. There have been many competitions that have been participated in, such as the Indonesia Drone Racing Federation (IDRF) starting the event in 2016 by holding a drone racing qualification round for the Asia Cup World Drone Prix championship in Dubai, Bandung aerial show in 2014, BFR (Bandung FPV racer) in 2014. 2017.

Research problem, In Indonesia itself, there have been many retail drones that have started with various brands, but retail drones in Indonesia do not yet have

sufficient facilities that involve customers and retail visitors more deeply to learn and experience drone technology directly and areas for drone activation without legal provisions.

the objective of the research. Apart from being used to detect goods piled up in warehouses, drones also aim to be used for inspection of warehouse buildings for maintenance purposes. Drones can get data on hard-to-reach parts such as roofs or poles that have the potential for corrosion, leaks or others. The other goal of this drone is to speed up the process of delivering goods directly to customers, especially as we know that from 2019, of course until now there is something called the Covid 19 virus disease which attacks or is transmitted from physical touch, crowds or you could say quite it's risky to meet in person, that's why many people in Indonesia and abroad order goods online to buy clothes, medicines, kitchen equipment, groceries etc. and the purpose of drones here is to avoid physical contact, speed up emergency deliveries such as sending drugs. Delivery of medicine or kits for self-quarantine using drones is considered easier to reach those who live in apartments. Because with this method there will be a lower rate of transmission of covid, because there is no need for contact between humans, and using this tool is faster and doesn't take a long time. The background of this research is to improve the Tourism industry in Indonesia especially related to transportation and logistic in supporting the Tourism.

Literature Review

Drones, in mechanical terms, are automated aircraft. Drones nowdays are more formally known as automated aeronautical vehicles or automated aircraft frameworks. Automaton is a flying robot that can be controlled remotely or fly autonomously via a flight plan program that is controlled within an installed framework, and works in conjunction with sensors and a locally available Global Positioning System (GPS). Currently, the proliferation of unmanned aerial systems, known as “drones”, is a reality for local policy makers, regulatory agencies, mapping authorities, startups and consolidated companies (Gonzalez-Aguilera & Rodriguez-Gonzalvez, 2017). At first, drones were discovered by Archibald Low from England in 1916, at that time. Drones were first used in World War I, at that time drones were used to carry out counterattacks. Drone itself comes from the word drone which means "male bee". Initially the term of drone was only used to refer to a simulated target that moved in the air (air moving targets) for shooting practice, from ground to air or from air to air In its development, drones are also used to refer to a UAS (unmanned aircraft system), unmanned aircraft. Drones are unmanned aircraft using a remote control as a controller. Drones are digital technology-based technologies with many specifications according to the use of the drone itself. The delivery drone was developed to fly and land vertically like a helicopter. In addition, drones can detect object movements better than humans can see. Thus, making this drone safe to use. According to the Federal Aviation Administration (FAA), drones have many functions in government, drones are widely used in the field of defense and security, especially as a tool to monitor or control all the wealth of the country including human resources, natural resources and those related to borders. boundaries of a country. Classification for the drone detection systems that were

based on the type of sensors that are used was performed. A detailed description of the radio frequency (RF)-based drone detection and defense systems was built, with an emphasis on the use of software-defined radio (SDR) platforms to implement such systems(Chiper et al., 2022). Drones are also widely used by mass media and television companies, especially as entertainment media such as acting and film, and are widely used by private people. In Indonesia, this drone has also developed quite rapidly. Before drones became widely known, actually aeromodelling activities or unmanned model aircraft were already quite widely followed by young people and adults.

Several e-commerce companies such as Amazon, JD.ID and Bukalapak already have the technology to send ordered goods using these drones. JD.ID plans to use drones to deliver goods to areas that are difficult to reach by land transportation. The development of goods delivery services with drones is carried out to save delivery time. Delivery by drone from the warehouse to the customer's house only takes 3-5 minutes, compared to delivery using an online motorcycle taxi which is estimated to reach 15-20 minutes, saving 75% to 80% time. To be sure, drone delivery will become a trend in the world of e-commerce. As the first terminological step to achieve better differentiation between passenger and logistics purposes we therefore propose to utilize the term Urban Air Logistics (UAL), which complements to the already wellestablished term of Urban Air Mobility (UAM) used to transport passenger (Kellermann et al., 2020).

Research Methodology

Methods used on this research is descriptive qualitative and quantitative taken from 25 of 155 participant on the the previous survey questionnaire during scientific forum of webinar FDM (Forum Dirgantara Muda) Sharing Session Episode. 7 with theme of Drone Industry Outlook 2022 held on 23 March 2022 as secondary data, the survey using google form and collecting method by email. The research variables is the drone technolgy development and sustainable logistic environment.

Results and Discussion

From Secondary data collected, related to the drone applicability in industry and curiosity of participant or public who want to know further about it.

Figure 1. Percentage Drone Industry curiosity from 25 Participant
[Source : FDM Survey March 2022].

This Shown that the participant or public want to know further about the business opportunity in the drone industry sector, as well as the research and technology development of business industry of drone, the percentage is 32 % for those matter. While 28% want to know the carrier related to the drone industry, and the rest 8% need to know the regulation and policy related to the drone industry. Therefore from those response, we then explain one by one about the data above.

1. The Business Opportunity in drone industry,

Offer solutions related to the issues raised, because The use of drones in Indonesia is of course very effective and efficient because Indonesia is an archipelagic country that has vast seas, mountains, hills and also dense cities. Sending goods by car can take up to two days and can be expensive. Meanwhile, using drones, goods can be delivered in at least 15 minutes. Not only sending goods but drones are usually used for military purposes, just a hobby, or for documentation. In Indonesia itself, the government already has regulations regarding the use of drones which are contained in the Minister of Transportation Regulation Number PM 47 of 2016. Drone technology is a new innovation that is phenomenal and has wide-reaching effects and has received the attention of today's society, being able to change the way humans think and work to become more effective and efficient. Drones have been widely used in various sectors. Good for agriculture, plantations, military needs, also for forest rehabilitation. For reforestation, several countries have started using drones to carry out aerial seeding of locations where human intervention is difficult. Drones can also be used for mapping, maintenance, and monitoring areas that are being rehabilitated. However, the use of drones for forest conservation in Indonesia is still not optimal. That could be argued when COVID-19 has enhanced technological progress in a lot of areas and there was possibility for drones represent a revolution in how we transport

goods and even ourselves. So in our opinion, new innovations from drones that have not been implemented in Indonesia are drones for sending/distributing goods whose locations are inaccessible, difficult to access vehicles, border areas and take a long time. This drone is very useful when applied in Indonesia because not all islands or areas in Indonesia can be traversed by land or sea vehicles. However, when using a drone for delivery of goods, there are several conditions or regulations that must be obeyed so that the delivery runs smoothly. The safety or cost trade-off will be an important one in contributing to the setting of safety rules appropriately which facilitate the industry without constraining it unnecessarily, including the development of low altitude airspace management systems in supporting the increased deployment (Merkert & Bushell, 2020).

Figure 1.Aerial Survey Location of Terra Drone Indonesia
[Source: Terra Drone Indonesia 2022]

Terra Drone Indonesia as a company which has experience in the last 5 years shows that we have successfully accomplished aerial survey of more than 600,000 hectares of concessions and 2,500 kilometers of corridors in various industry sectors including gas and oil, mining, construction, plantations, and utilities. By using the solutions that company developed, so they committed to deliver high quality results quickly, effectively, precisely, and efficiently, on a scale that previously was unimaginable.

Drone Industry Insight has done another market size and forecast for the next 5 years and shown that the market is still growing with CAGR (Compound Annual Growth Rate) of 13.8%. Currently, it is estimated that the market size is $22 billions, and will be doubled in 2025. Besides, the breakdown also shows that Asia will have the biggest growth in the course of 5 years. This is because more and more developed and emerging countries adapt the technology to maximize the outputs of their work. This include Japan, China, India, and South East Asia, this projection can be seen on figure 2 below.

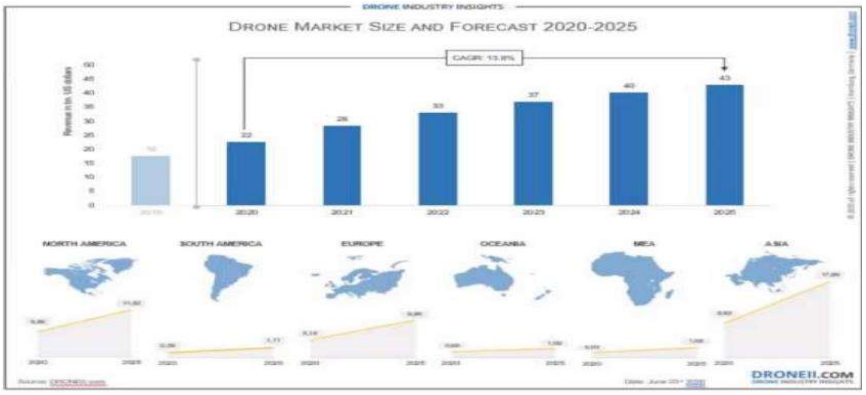


Figure 2. Drone Market Size and Forecast based on Continent from 2020-2025
[Source :DroneII,com]

The Marker of drone in 2021 was grow at 9.4% CAGR and reach US$41.3 billion by 2026. put this into context, the global market of helicopter is currently valued at US$48.2 billion by Statista; drones will likely reach this number within a decade even though helicopters have been around for much longer. It Roughly 78% of drone-related revenue globally is generated through services rather than hardware or software. This segment is set to grow at a rate of 9.6% CAGR and reach US$30,7 billion by 2026. The service segment is mainly driven by business-internal drone activities, i.e. companies that use drone technology for their internal business processes. This share is more than 70% within services today and will _increace in the future as shown on figure 3 below :

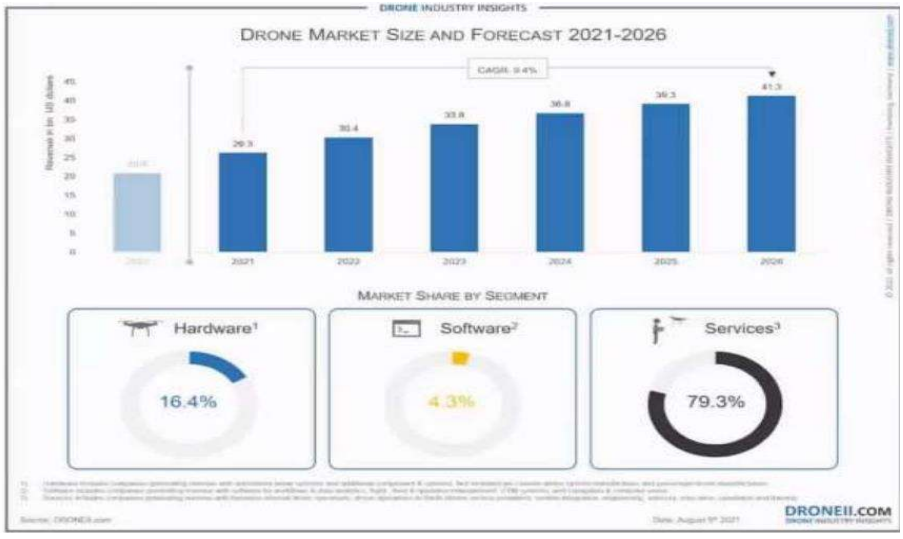


Figure 3. Drone Market Size and Forecast based on technology support development from 2021-2026
[Source : DroneII.com]

2. Carrier in Drone Industry sector.

The application of drone involve some Parties that help implement it , In order to open up new innovations for the use of drones in Indonesia as a means of transporting goods by air, this unmanned aircraft certainly requires several parties, in each party the there are some carrier or job can be done , so below the parties and the activity of each party or stake holder.

• Government

The government here is very influential because of course the use of unmanned aerial vehicles is not easy, there are a number of things that must be considered starting from not being allowed to cross restricted areas, restricted areas, airport areas, need permits for use other than hobbies and recreation, fines and penalties for violators. Of course all of that must have permission from the government.

• Company Owner

Of course, the cost of using drones is not cheap and easy, so there needs to be support from company owners, whether delivery services or buying and selling companies who want the goods to be delivered directly using their personal drones, as is done by several companies, namely Amazon, Bukalapak, JD ID etc. More Utilization by Oil Companies ,Oil companies have received the benefits of drone technologies especially in terms of safety & cost, and will continue to take benefit especially in this uncertain situations. This will include: Applications for asset integrity & asset management ; - Utilization for security patrols; - Drone technology for oil & gas exploration. Construction company, Standard Tools for Construction Drone already became a standard tools in construction especially for construction progress monitoring, and this will continue with more adaptations especially in doing surveys using LIDAR. (Light Detection and Ranging) for Topography survey and for feasibility studies ; initial designs; Cut & fill volumetric calculation ; Design verification and commissioning. Mining Company , Mining will Continue to Adapt Same with the other two sectors, mining also already took benefits whether in exploration, construction, production, and reclamation. More application will take over: Volumetric calculation for stock opname; Survey for slope stability; - Drone for coal & mineral exploration. Electricity Power , More Application in Power & Utilities PLN and its subsidiaries already have some experience in applying drone for their business and this will continue to happen in the following years which include: Powerline survey & inspection; Cable stringing; Power plant & facility asset integrity; Route planning.

• Person Ordering Goods/HR (Human Resources)

In issuing transportation means for sending goods using drones, of course HR people or as potential buyers and potential users are very important to support the existence of means of transportation of goods using these drones.

• Farmer or Agriculture

In the coming years, all possible uses of drones will be perfected by drone service providers and farmers themselves. Increased harvest intelligence will make the farms more efficient and help to complete smaller operations with their wealthier competitors of Big Agriculture (Veroustraete, 2015)

The Age of Agricultural Drones, More and more government bodies are opening their door for new technologies especially for the ones related with agriculture as the foundation of the country. One of the demand will come for drone spraying and its applications in agriculture.

• Freight Forwarder service and warehouse company

This Freight Forwarding service company plays an important role in the operation of delivery drones, Freight Forwarding is tasked with providing goods delivery services from companies to consumers.

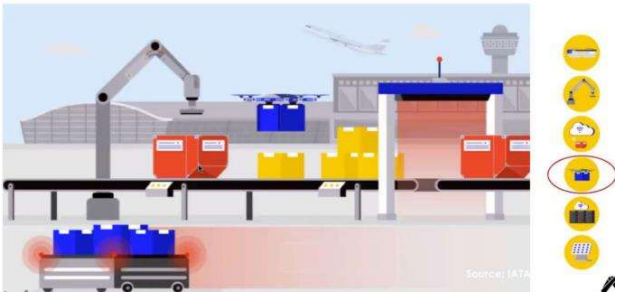


Figure 4. Cargo Facility in the future using Drone to assist Cargo Movement. [Source : FDM webinar (2022)]

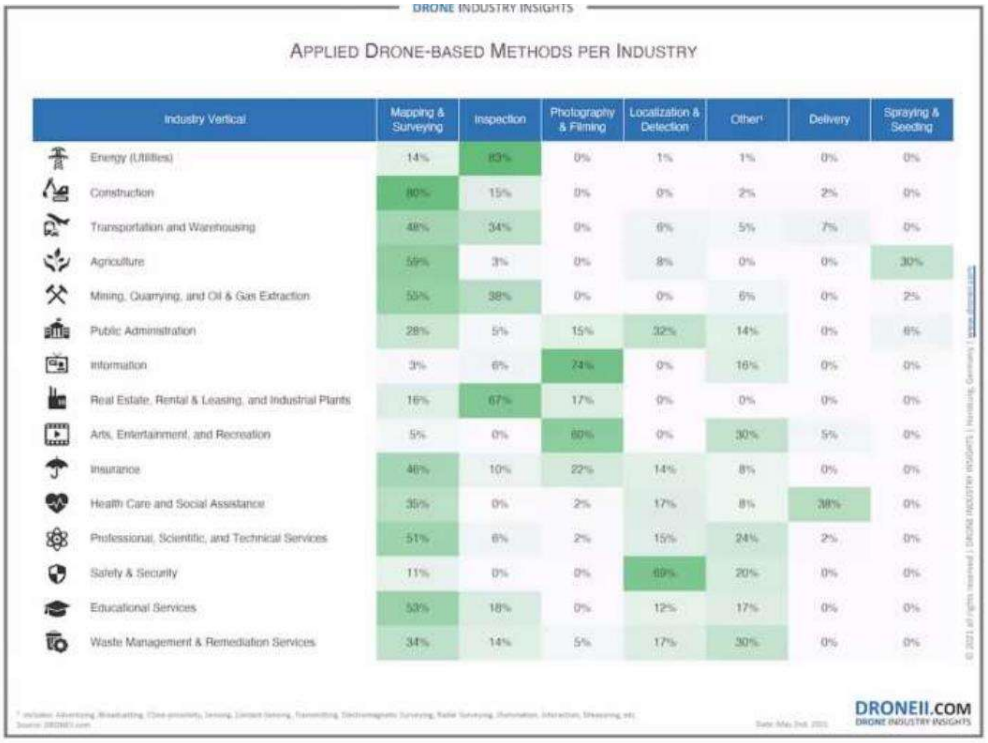
The potential strengths of applying drones in Supply Chain Management (SCM) and logistics as follows 1) supporting the humanitarian logistics, 2) reducing the delivery time, 3) reducing the cost, 4) improving the flexibility, and 5) increasing the sustainability. additionallt, the challenges posed by drones in SCM and logistics are grouped into technical, organisational, safety-related, and regulatory issues (Rejeb et al., 2021)

• BNPB (National Disaster Management Agency)

Take More Role in Disaster Response, BNPB already acknowledge drone as one of the important tools in the context of disaster response. More and more applications applications are adapted to help the government getting more accurate information about the disaster management as well as the risk for disaster mitigation. This will continue to evolve in the upcoming years. In situations of disaster, the disaster victim identification (DVI) team frequently encounters problems in locating and retrieving victims, this may resulting of body decomposition and identification delays. Although conventional victim identification methods are available, they have been ineffective in gathering victim information due to geographic location or disasters involving inaccessible sites. By the assistance the technology of drone, concerted effort and cooperation from relevant multidisciplinary teams, and evidence-based data, it might be possible to avoid DVI delays and the numerous problems that accompany them (Mohd Daud et al., 2022)

- Drone Manufacturing Industry

The drone manufacturing industry is a company or factory that will later assemble and manufacture drones for these logistics activities.



Industry Vertical	Mapping & Surveying	Inspection	Photography & Filming	Localization & Detection	Other*	Delivery	Spraying & Seeding
Energy (Utilities)	14%	83%	0%	1%	1%	0%	0%
Construction	80%	15%	0%	0%	2%	2%	0%
Transportation and Warehousing	48%	34%	0%	6%	5%	7%	0%
Agriculture	59%	3%	0%	8%	0%	0%	30%
Mining, Quarrying, and Oil & Gas Extraction	55%	38%	0%	0%	6%	0%	2%
Public Administration	28%	5%	15%	32%	14%	0%	6%
Information	3%	6%	74%	0%	16%	0%	0%
Real Estate, Rental & Leasing, and Industrial Plants	16%	67%	17%	0%	0%	0%	0%
Arts, Entertainment, and Recreation	5%	0%	60%	0%	30%	5%	0%
Insurance	46%	10%	22%	14%	8%	0%	0%
Health Care and Social Assistance	39%	0%	2%	17%	8%	38%	0%
Professional, Scientific, and Technical Services	51%	6%	2%	15%	24%	2%	0%
Safety & Security	11%	0%	0%	69%	20%	0%	0%
Educational Services	53%	18%	0%	12%	17%	0%	0%
Waste Management & Remediation Services	34%	14%	5%	17%	30%	0%	0%

Figure 5. Applied Drone Based Methods Per Industry
[Source : DroneII.com]

Some of the main uses for drones are currently 1) to map and survey and 2) to do inspection. In the Energy sector, roughly 83% of the time drones are used to carry out inspections. For other industry where drones are mostly used for inspections such as Rental & Leasing, Real Estate and Industrial Plants (67%). Meanwhile, in Construction, drones are mostly (80%) used for mapping and surveying. This also happen in other industries such as Agriculture (59%), Mining, Quarrying and Oil & Gas Extraction (55%), and several other industries, though these applications are more diversified. The third major application of drone within industries is photography and filming, which many people outside of the industry are very familiar with. This application represents 74% of drone usage in the industry of information as well as 60% of their use in Entertainment, Arts and Recreation.

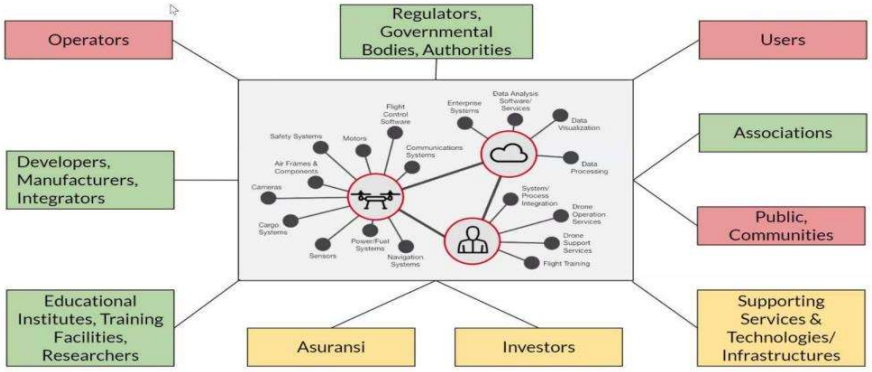


Figure 6. Drone Ecosystem and Stakeholders
[Source : Terra Drone Indonesia]

3. Research and technology development of Drone Industry

Start from the prediction of delivery timeline from 2018 to 2025, Commercial suitability, safety and regulatory standards based design, platform and payload adaptability, intelligent piloting models and full autonomy, automated safety modes, and airspace awareness.

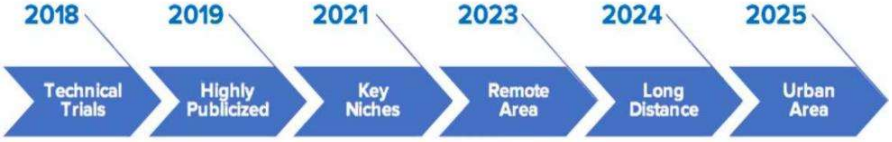


Figure 7. Drone industry technology development delivery timeline
[Source : Terra Drone Indonesia]

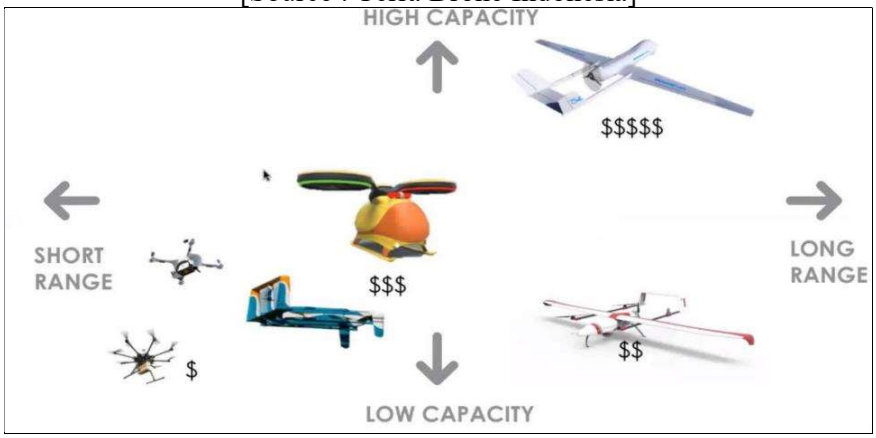


Figure 8. Operational Envelope approach
[Source ; Terra Drone Indonesia]

The practice in establishing such an operational envelope via verification examination has emanated from the risk considerations wherein airworthiness agencies have a definite role to play. Airworthiness assurance process consists of a sequence of events starting from design reviews, simulation tests encompassing the level of systems and component level tests (Samuel et al., 2016).

Figure 9. Maximum Capacity, Range and Endurance of Drone type
[Source; Terra Drone Indonesia]

Current Products, must concerned with Safety and Regulations, Technology Reliability, also Power and Energy Efficiency. There are two types od drones, such as quadcopter and fixed wing. The advantages of a fixed wing system can lift the load with its wings, so that the drones can lift quicker (Suroso & Irmawan, 2018).

4. Regulations and Standards Policy

Updated Process in Obtaining Permits, There has been some changes in the process of obtaining required permits to legally operate the drone in Indonesia. The process is much clearer than before, yet there are new pre-requisites to obtain before going through the application. As we can see on the figure 6 below

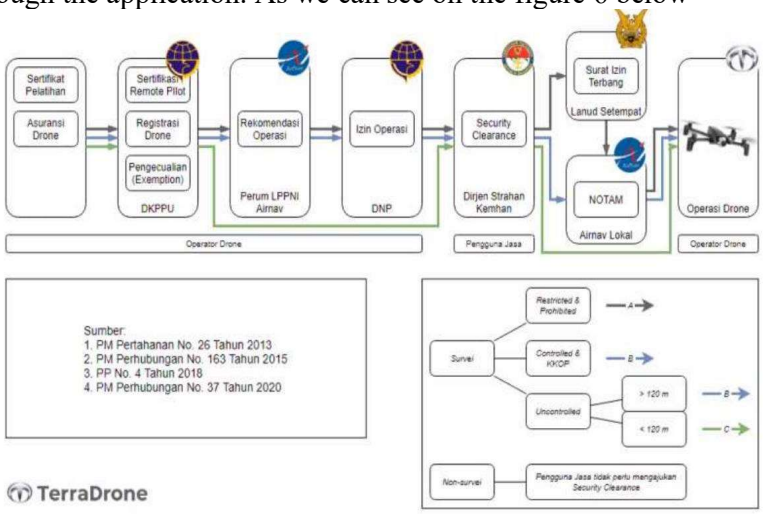


Figure 10 : Updated Process in Obtaining Permits
[Source : Terradrone Indonesia]

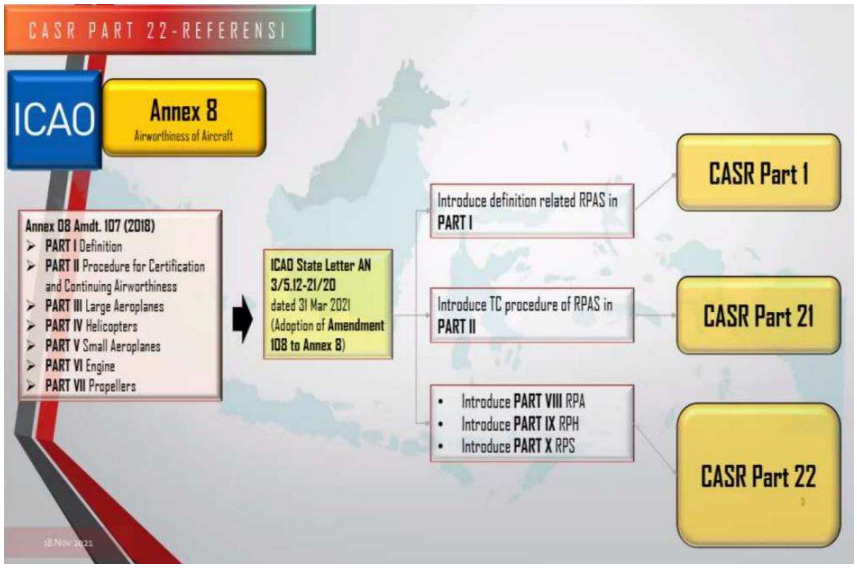


Figure 11 : International Regulation based on ICAO Annex 8 Amdt 108(ICAO Annex-8-Airworthiness-of-Aircraft, 2021)
[Source; Terra Drone Indonesia]

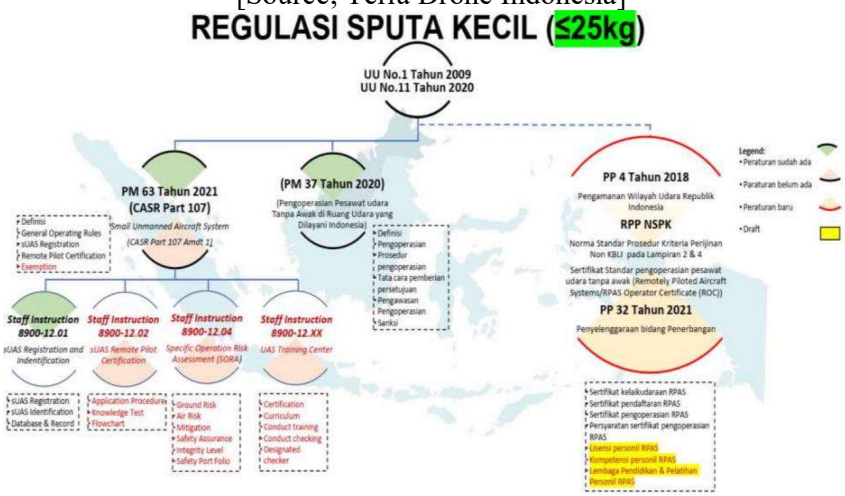


Figure 12 : National Regulation of Drone
[Source : Terra Drone Indonesia]

Conclusions

The objective of this paper is Apart from being used to detect goods piled up in warehouses, drones also aim to be used for inspection of warehouse buildings for maintenance purposes. Drones can get data on hard-to-reach parts such as roofs or poles that have the potential for corrosion, leaks or others. The other goal of this drone is to speed up the process of delivering goods directly to customers , those can be accomplished by unmanned aerial vehicles/drones nowadays, this is really needed, especially during the pandemic Covid-19 and any emergency situation, the use of drones for the delivery of goods, medicines or other things can reduce covid transmission and save time. Drones can offer a big number of services in this era.

A Drone or UAV's not only minimizes the risk of contact, they had been used for aerial monitoring of containment or curfews areas, for evaluation of post-massive epidemic contagious diseases, for reaching the inaccessible areas and a lot of mores (Gupta et al., 2021)

But of course there are challenges and obstacles to the application of these drones, namely the operation of drones must prioritize safety, security and compliance in the aviation sector, there are several challenges in the development of drone technology, especially for commercial use in Indonesia, especially in urban areas.

According to our predictions, drones for logistics activities will be made and operated within the next 5-10 years. Because of course there are also many obstacles and challenges for the manufacture and operation of this drone. The benefits of having drones for logistics in the future are to speed up the process of shipping goods and minimize physical touch.

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