

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area

Bambang Edhi LEKSONO, Agoes Soewandito SOEDOMO, Didik Wihardi W. SOEROWIDJOJO, Levana APRIANI, and Nanin Trianawati SUGITO, Indonesia

Key words: Cadastre; Land management; Remote sensing; Highway; Land acquisition; UAV

SUMMARY

The construction of highway is one of the most important development because it concerns human accessibility. Highway is not only solution for overcoming the traffic, but also increase the economy development of the state. Many areas in Indonesia which have less potential of economic development, but after construction of highway, the economic of those areas increase, because the accessibility of the area is increasing and many investors are interested in investing. This research takes in Cileunyi - Sumedang - Dawuan (Cisumdawu) Highway construction area. At the time of planning highway there are some obstacles related to land acquisition. Land acquisition is a fairly sensitive issue and can lead to conflict as it relates to ownership and value of a person's land. The solution offered to minimize conflicts in the field is to use unmanned aerial vehicle (UAV) technology. UAV technology generally uses air-controlled drone aircraft and takes the area around the Cisumdawu Highway construction area. After obtaining the Cisumdawu Highway area, it is then performed in a plot of land parcels integrated with the land value. Using UAV technology, the land valuation scheme will be easier to compensate for further negotiations with local community and minimize field surveys that may arouse suspicion within the community.

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area
(9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies
Istanbul, Turkey, May 6–11, 2018

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area

Bambang Edhi LEKSONO, Agoes Soewandito SOEDOMO, Didik Wihardi W. SOEROWIDJOJO, Levana APRIANI, and Nanin Trianawati SUGITO, Indonesia

1. INTRODUCTION

Construction of highway is one of the most important development because it concerns human accessibility to a place quickly. This is because the expressway is identical with the freeway. In Indonesia, highways are not new, even today the government is intensively developing the highways. This is the result of an ever-increasing volume of vehicles every year. Currently, there are four highways in preparation for the tender, such as Cileunyi - Sumedang - Dawuan Highway, Manado - Bitung Highway, Pandaan - Malang Highway and Balikpapan - Samarinda Highway at a rate of around 3.2 trillion and its investment value is 31 trillion. The highways currently in the tender process are Serpong - Balaraja Highway and Pasirkoja - Soreang Highway with an investment value of about 7 trillion (Badan Pengatur Jalan Tol, 2015).

From the above data it can be ascertained that the highway is a crucial necessity and has a high investment value. Highway not only serves as a solution to congestion, but also with the construction of highways also drive the state economy. Many of the previously less economically viable regions of Indonesia, once the highways are built around them, the accessibility of the area has increased and many investors are interested in investing. The Cisumdawu Highway is a 60 kilometer highway part of the Trans Java Highway in West Java connecting Cileunyi - Sumedang - Dawuan or Padaleunyi Highway with the entire Palimanan - Kanci Highway using an area of 825 ha (Wikipedia, 2014). Until now, the development of Cisumdawu Highway still leaves the land problem.



Source: Ujung Jaya Online, 2012
Figure 1.. Cisumdawu Highway Development Plan

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area (9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies
Istanbul, Turkey, May 6–11, 2018

The recent development is that Cisumdawu Highway does not have a budget for land acquisition, whereas physical development is heavily dependent on accelerating the provision of land. Currently there is still a lot of land that has not been released yet. as an example of the Cisumdawu Highway development process in section 1 Cileunyi - Rancakalong 12km long. Currently, the provision of land is only about 37%. Although it has been added to the land of the Institut Pemerintahan Dalam Negeri (IPDN) of 60.63 ha, it can only reach 68.63%. In addition to land acquisition problems, there are also construction problems. The difficulty, namely building a junction on the main road The intersection of the mainroad, deliberately made to access traffic vehicles at the intersection Cileunyi, not to break. That condition, when starting physical work at the base of Cisumdawu toll. Cileunyi intersection, such as in and out of vehicles at the Cileunyi toll gate, Bandung-Garut Highway and Cileunyi-Cibiru. If the flow of traffic is cut off, the impact will be a total congestion on a number of major roads (Pikiran Rakyat, 2017).

Section II is on the Rancakalong - Sumedang section along the 17.2 km, can only be completed in phase I of Rancakalong - Ciherang along the 6.35 km. Phase II Ciherang - Sumedang, the provision of land has reached 80% while physically 41%. In phase II there is a tunnel along 472 meters which is the only tunnel on the highway in Indonesia. It can be concluded that phase II as a whole is targeted to be completed in September 2019. Section II is a section awaited by many communities. The development of section II can be a solution to the vehicles in Jalan Cadas Pangeran (Pikiran Rakyat, 2017).

In addition to section I and II, there are also sections III and IV made during Sumedang to Dawuan, Majalengka District along 31.05 km. It's just that this section is easier because of the flat and flat ground conditions (Pikiran Rakyat, 2017). In addition to the ease of traffic, the construction of Cisumdawu Toll also facilitate public access to West Java International Airport in Kertajati, Majalengka District. Currently being built access from Cisumdawu Toll to West Java International Airport in Kertajati, Majalengka Regency (Sindonews, 2017). So Cisumdawu Toll not only overcomes congestion in Sumedang area, but also helps to overcome traffic jam due to the fact that vehicles are visiting Soekarno Hatta International Airport, because with the Cisumdawu Toll and Cipali Toll, West Java people can go to West Java International Airport. This can also reduce the accumulation of passengers for international purposes.

2. METHODOLOGY

2.1 Using of UAV

UAV or called an unmanned aerial vehicle is a flying vehicle that has the ability to operate without the existence of pilot in the rides. Usually UAVs are controlled remotely and can be either aircraft or helicopters that use standalone systems (Transport Canada, 2012). Until now UAV is used for military purposes. But many also use for air and civil surveys that are required by governments and private parties in Indonesia. The cost of a UAV survey is far more cost-effective than aircraft berakak, and minimal risk if necessary observation or surveillance in

areas of conflict and dangerous. With the ability to fly at low altitudes (about 250 m above ground level) can produce very accurate aerial photographs up to 1: 1.000 scale (Robo Aero Indonesia, 2012).

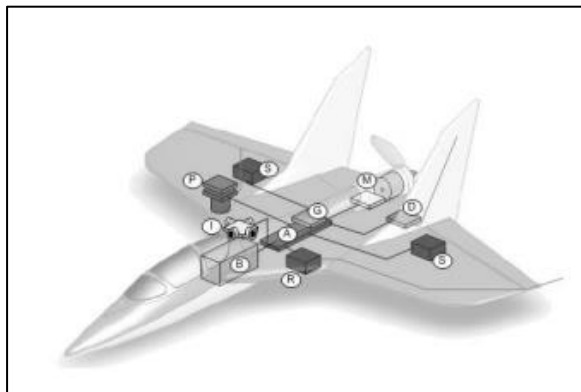
Generally, UAV systems are formed by several interacting parts, such as planes and earth control stations shown in Figure 2.



Source: Zone of Electro, 2014

Figure 2. UAV device

The aircraft is the most important part in the UAV. For the aircraft parts of the UAV shown in Figure 3 (Iman, 2007).



Source: Zone of Electro, 2014

Figure 3. Aircraft UAV

- | | | | | | | | | |
|---|---|-------------------|---|---|--------------|---|---|-------------------------|
| A | : | Autopilot control | G | : | GPS receiver | R | : | RC receiver and antenna |
| B | : | Battery | I | : | IR Sensor | S | : | Servo |

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area (9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

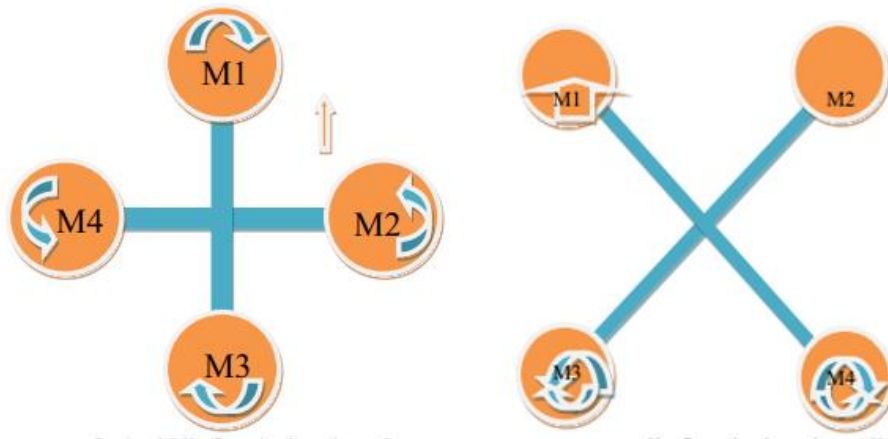
FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies

Istanbul, Turkey, May 6–11, 2018

D : modern radio & antenna M : Motor control and P : Payload, camera, and video transmitter

The UAV used is a multirotor UAV whose rotor count is four pieces and is used as a motion control on this vehicle, or so-called quadcopter or quadrotor. based on its configuration system differentiated on quadcopter P and quadcopter X, can be seen in Figure 4.



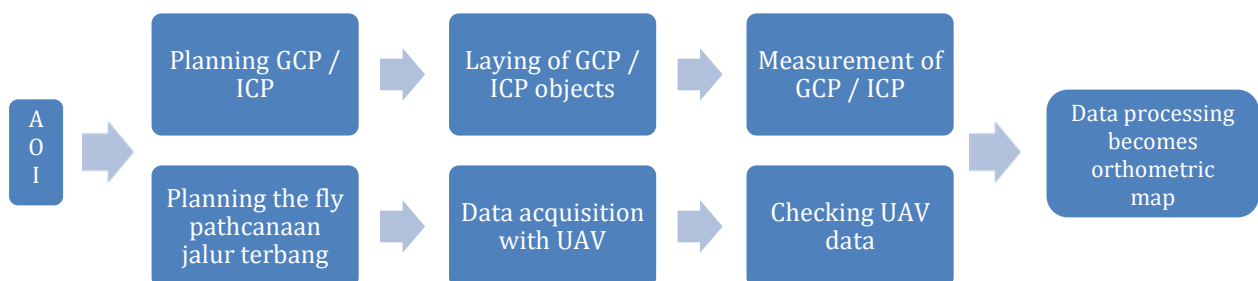
Source: Primary, 2013

Figure 4. Quadcopter

This type of UAV is a type of UAV that is widely used for now. There are still some types of UAVs such as bi-copter, tri-copter, and hex-copter that are distinguished by the number of rotor (Utama, 2012).

2.2 Method

The data were collected by UAV in Cisumdawu Highway Development Area. For step-taking data is done with UAV in Cisumdawu Highway construction area. For the steps described in the steps in Figures 4 and 5 above are described in step 4 and 5.



Source: Doc. Private, 2017

Figure 5. Flow Chart Mapping with UAV

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area (9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies

Istanbul, Turkey, May 6–11, 2018



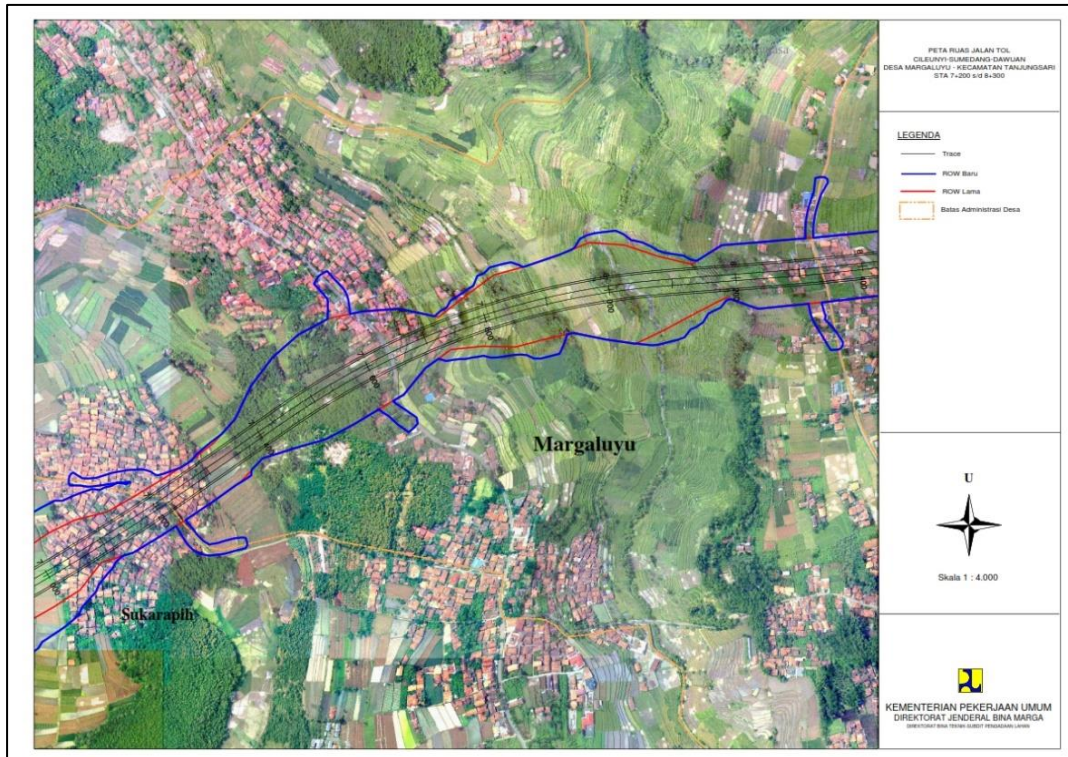
Source: Consultant Survey Services, 2014
 Figure 6. Description of Mapping Process with UAV

The first time to do is to determine the Area of Interest (AOI), in this study is around the area of Cisumdawu Highway construction. After that done premarking to put Ground Control Point (GCP) or Independent Control Point (ICP). As far as possible GCP / ICP is placed in an open place, so that when the flight is easy to see. GCP survey using GPS, after the completion of GPS survey placed the mark of a cross-shaped premark with a bright color to look from above. GCP survey is very influential on the geometric accuracy of orthometric maps. According to Indonesian National Standard (SNI), the distance between GCP 2.5 km.

When performing GCP / ICP measurements, it can perform a flyway planner. The aircraft must calculate 60-70% overlap and 30-40% for sidelap. Once planned, then it's time to do a UAV flight. Make sure the carrier checks the current area of the flight, whether there is a missed area or an invisible GCP. Afterwards check again to make sure there is an area missed. After that is done GCP data processing with photo data to get orthometric maps used for land acquisition.

3. RESULT AND DISCUSSION

This section will show the results of the UAV survey, along with the results of the digitized land parcels located in the area.



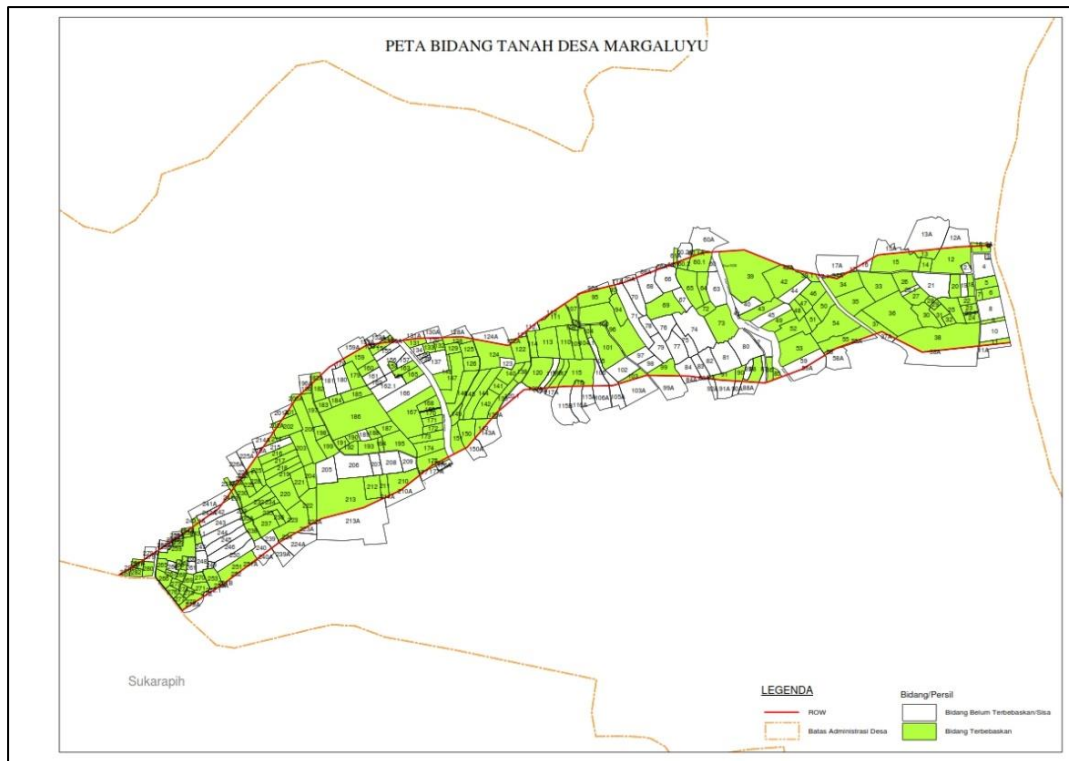
Source: Ministry of Public Works, 2017
 Figure 7. Orthometric Map of UAV Results

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area (9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies
 Istanbul, Turkey, May 6–11, 2018



Source: Doc. Personal, 2017
 Figure 8. Results of Digitizing

The information in Figure 7 is about any land that has not been released yet. On the part of the white land means not yet released. From the results dijitasi with the basic map of UAV shooting results then dapat calculated how land that has not been released with the help of software ArcGIS 10.3 and there is also data of land use. Calculated also for the land already paid until 2015 at the Village Margaluyu, Tanjungsari District there are 194 people's land with an overall area of 91.656 m², while the price paid is about 18 billion rupiah. For the unpaid and the comparison graph can be seen in Table 1 and Figure 8.

Table 1. Unpaid Land Cumulative Table

Component	Total Field	Area (m ²)
Citizen Land	90	34,987
Land of Wakaf	3	1,556
Land of BUMN	1	118
Village Assets	8	2,357
Regency Asset	2	2,743
	104	41,761

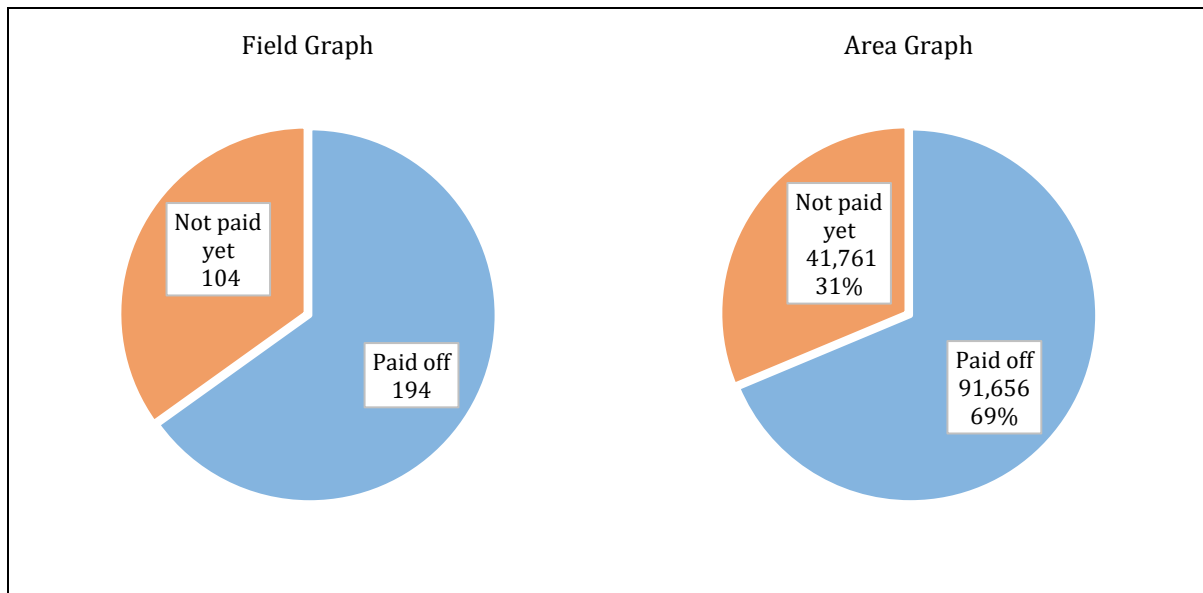
Source: Doc. Personal, 2017

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area (9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies
 Istanbul, Turkey, May 6–11, 2018



Source: Doc. Personal, 2017

Figure 9. Graph of Unpaid Land and Land Size

On the chart looks a percentage that has paid more than the unpaid, although the percentage is not too much different. The amount in rupiah data is calculated from the price estimation. From this result it can be seen that UAV can be used to assist in land acquisition. After a partial land clearing, it can be calculated then by asking the government or local residents or even searching through the land / house sale site, a price assessment can be made.

By using the UAV can also dbedakan which is empty land and buildings, because the value of a land will be different if there is no building or not. Then in the process of land acquisition, the plant will also be calculated if the land is used as rice fields or plantations. The use of UAVs will minimize conflicts in the field, so that the measurement process can occur more quickly and usually before the local village village's UAV measurements have provided some kind of announcement letter if the citizens' land will be used for public purposes. Then with the UAV can help overcome the people who sometimes raise the price of land as high as possible, without doing price comparisons with neighbors.

4. CONCLUSION

By using UAV, the process of land acquisition can be done safely and quickly. Safe because it can minimize conflict with local people, who generally do not want the land sold even for public purposes. Fast because no need to make the arrival to each home one by one, simply by taking a photo, then done dijitasi. Generally, land related data already exists in local village apparatus.

REFERENCES

- Iman, D.P. (2007). *Rancang Bangun Sistem Telemetri pada Wahana Udara Tak Berawak*. Undergraduate thesis. Bandar Lampung: Universitas Lampung
- Utama, M.R.W. (2013). *Sistem Kendali Holding Position pada Quadcopter Berbasis Mikrokontroler Atmega 328P*. Undergraduate thesis. Bandar Lampung: Universitas Lampung
- <http://bpjt.pu.go.id/>
- <https://id.wikipedia.org/>
- <http://www.pikiran-rakyat.com/jawa-barat/2017/03/10/percepatan-tol-cisumdawu-395873>
- <https://daerah.sindonews.com/read/1218386/21/akses-tol-bandara-kertajati-mulai-dirancang-1499325221>
- <http://www.tc.gc.ca/civilaviation/general/recavi/Brochures/uav.htm>
- <http://www.roboeroindonesia.com/>

BIOGRAPHICAL NOTES

Dr. Ir. Bambang Edhi LEKSONO, M.Sc, born in 1957, Graduated in 1982 as Engineer in Surveying and Mapping from Bandung Institute of Technology (Indonesia), obtaining Master degree in Urban Survey & Human Settlement Analysis (ITC-Holland) in 1990 and doctorate degree in Geography in 1996 from Universite de Nice Sophia Antipolis (France). Now, Dr. Ir. Bambang Edhi Leksono, M.Sc is member of Survey and Cadastre Research Group in Institut Teknologi Bandung, Indonesia.

CONTACTS

Dr. Ir. Bambang Edhi LEKSONO, M.Sc
Survey and Cadastre Research Group, ITB
Labtek IX-C 3rd floor, Jl Ganesha 10,
Bandung- 40132
INDONESIA
Tel. +62.22.2530701
Fax. +62.22.2530702
Email: bleksono2013@gmail.com
bleksono@gd.itb.ac.id
Web site: -

The Using of Unmanned Aerial Vehicle (UAV) Technology for Land Acquisition in Highway Construction Area (9347)

Agoes Soewandito Soedomo, Bambang Edhi Leksono, Didik Wihardi W. Soerowidjojo, Levana Apriani and Nanin Trianawati Sugito (Indonesia)

FIG Congress 2018

Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies
Istanbul, Turkey, May 6–11, 2018