

Deregulation Necessity for the Invigoration of Drone Utilization in the Geospatial Information Field

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Abstract

In this study, a direction for deregulation that can increase the use of drones in the field of spatial information is presented. Regulations and administrative procedures for drone operation showed similar procedures in Japan, the United States, and Korea, such as reporting flight equipment, driver's license, and prohibition of flying within a specific flight zone. In the United States, policies to encourage the use of commercial drones have been implemented, and Japan has slightly tightened regulations on drone operation to protect the Olympics and important national facilities. As a result of the study, in the area where drone operation is restricted for geospatial data construction, Korea was setting the largest area, and GIS analysis showed that Korea's drone flight restricted area was more than 19.4% of the country's land area. In order to increase the utilization of drones in the construction and utilization of spatial information in the future, it is necessary to reset the drone flight restriction zone and reduce the area of the drone flight restriction zone. In addition, it was found that Korea is the only country that has formal and specific regulations on geospatial information security management. In order to increase the construction of geospatial information using drones, it is necessary to ease GSD (Ground Sample Distance) regulations.

Keywords : Deregulation, Drone, Geospatial Information, Legal System, Restricted area

1. Introduction

In the past, drones were operated within a municipal distance, but now, combined with information and communication technology, the GNSS (Global Navigation Satellite System), flies over visibility, moves along a set operating track, obtains various information, and returns to the starting point(Cho *et al.*, 2020; Park and Lee, 2022). The use of drone geospatial information is being used in various fields. It is being used in the real estate field that requires immediateness, economy, and combination with spatial information, which is an example applied to a representative smart city field. In addition, it is possible to measure whether

a new building has shadow damage by time zone(Park and Lee, 2022; Kim and Lee, 2021). In the field of urban planning, aerial photos are continuously taken every year for various purposes, such as intellectual reinvestigation zones, urban planning facilities review, restriction on development, and survey on public property(Han, 2021; Lee, 2021). In the environmental field, it is used for control tasks such as managing pollutant emission sites, neglecting illegal dumping and waste management, cracking down on scattering dust generation sites, and monitoring environmental pollutants. The disaster safety field is used for safety inspection of facilities using drones and investigation of disaster sites, and in the tourism field, it is used for building promotional

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video materials for tourist attractions in the province(Kim, 2021). Drone geospatial information technology is used in prediction and simulation fields, and in government work, 3D geospatial information is used throughout administrative work, especially in urban planning(Kim *et al.*, 2021). Table 1 shows the field of application of drone geospatial information.

Table 1. Application of drone geospatial information

Field	Applications
Public sector	<ul style="list-style-type: none"> • Basic plan: Urban basic/management plan, transportation plan, landscape plan, district unit plan, reconstruction plan, etc • Facility management: Installation and management of facilities, management of cultural properties, urban disaster prevention, firefighting work
Government work	<ul style="list-style-type: none"> • Urban facility management, cultural heritage management, park green area management, building permit, three-dimensional facility management, three-dimensional urban management, urban environment management, tourism, and public relations
Military	<ul style="list-style-type: none"> • Arrangement of facilities, military movement, street warfare, ground warfare, bombing, chemical warfare, etc
Science	<ul style="list-style-type: none"> • Design diagnosis of architecture and civil engineering structures, facility fire prediction simulation
Private sector	<ul style="list-style-type: none"> • Information provision for civil engineering and construction 3D game and navigation industry Internet portal map service

Geospatial information using drones is used throughout administrative work, and its use in urban planning is particularly prominent. The three-dimensional spatial information expresses space similar to the real world, and is used in various ways in the realization of digital twins and overall administrative work. However, due to the armistice with North Korea, the use of drones for geospatial information construction is limited in Korea. Therefore, in this study, in order to suggest a direction for increasing the use of drones in the geospatial information field, the legal and institutional aspects related to the operation of drones and spatial information were compared with the current status of

foreign countries and Korea. Fig. 1 shows study flow.

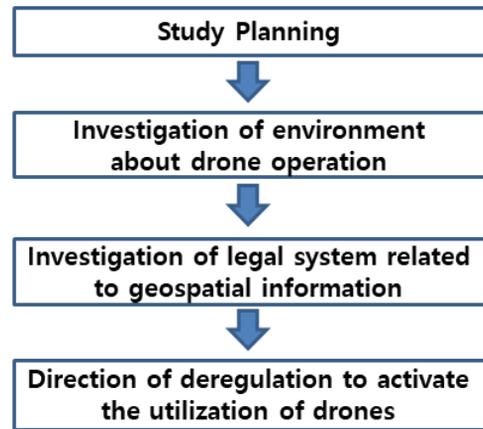


Fig. 1. Study flow

2. Environment for Drone Operation

2-1. Airspace for Drone Operation

In this study, the related status of Korea, Japan, and the United States was investigated as a survey on the environment for drone operation. In Korea, the legal concept of 'drone' is 'UAV (Unmanned Aerial Vehicle)' among 'ultra-light vehicle' under the 'Aviation Safety Act'. In this study, the term representing this was unified as 'drone'. When using drones for non-commercial purposes, business registration is not required, but to use drones for profit, you must register for a business using ultra-light aircraft under the Aviation Business Act and purchase insurance or mutual aid. Non-commercial drones exceeding 12kg in weight and the owner or right to use all commercial drones must report the device, receive a report number, and display it on the drone. In addition, if the maximum take-off weight exceeds 25 kg, flight approval is required (not required when flying in an area dedicated to ultra-light aircraft) and safety certification must also be obtained. Drones with a maximum take-off weight of 25kg or less do not need flight approval in principle, but flight approval is also required to fly at an altitude of 150m more or a control area include Seoul. At this time, in order to fly a drone that weighs more than 12kg, a proof of the coordinator is required. After completing these settings, you can fly the drone. In this case, operator must follow the provisions of

Article 129 of the Aviation Safety Act and Article 310 of the Enforcement Rule of the same law (Ministry of Land, Infrastructure and Transport, 2022). Accordance to the Aviation Safety Act and Airspace Management Regulations, No-fly zone is an airspace where the flight of aircraft is prohibited for safety, national defense, and other reasons, and a restricted area is an airspace where the flight of an aircraft without a flight permit is restricted (Korean Law Information Center, 2022). Control zone is the airspace under Article 2, No. 25 of the 'Aviation Safety Act', which provides air traffic control services for aircraft performing visual and instrument flight. Apart from flight approval, when taking pictures using a drone, the drone operator is required to apply for an aerial photography permission according to the 'Aerial Photography Guideline' of the Ministry of National Defense. In addition, if there is a security area after filming, the person in charge of the military unit will check the photos (<https://drone.onestop.go.kr/>).

In the case of Japan, the 'Aviation Act' indicates regulations on drones. In the case of drones subject to Japan's Aviation Act, in order to prevent colliding with people or objects on the ground or water, a distance of 30 m between the drone and people or objects must be secured to fly. Here, 'person' refers to a person other than the operator of the drone and its direct or indirect person concerned, and 'object' refers to vehicles, buildings, and other large-scale structures other than natural objects such as land and trees. Those owned or managed by the person flying the aircraft and their direct or indirect persons are excluded. In addition, according to Japan's Aviation Law, unmanned aerial vehicles are restricted

from flying over places where ceremonies, exhibitions, and other large gatherings are held. Drones used to construct geospatial data must also follow these regulations.

In the United States, the DOT (Department of Transportation) and the FAA (Federal Aviation Administration) prepared the 'UAS NPRM (Notice of Proposed Rulemaking) for the purpose of revitalizing the commercial small UAS market' in 2015. It also announced the 'Summary of Small Unmanned Aircraft Rule', the rules for operating commercial drones. The United States divides the purpose of operating drones into hobby and commercial purposes, and stipulates operating aircraft, pilot qualifications, airspace, and operating rules accordingly. The United States has similar drone flight requirements to Korea and Japan. Also, filming in military areas like Korea was prohibited. However, in the case of the United States, it can be seen that various regulations are being reduced to activate commercial drones. FAA is pushing ahead with plans to allow drones to fly over crowds or fly at night (Federal Aviation Administration, 2022).

As mentioned above, restrictions on drone operation in the construction of geospatial information are determined by Japan, the United States, and Korea. Japan restricts the flight of drones around airports, and the United States and Korea restrict flying around airports and military facilities. In this study, the flight airspaces of drones in Japan, the United States, and Korea were compared. Fig. 2 shows the restricted areas for flying drones by country (Ministry of Land, Infrastructure, Transport and Tourism, 2022; Seoul Regional Office of Aviation, 2022; U.S. Department of Transportation, 2022).

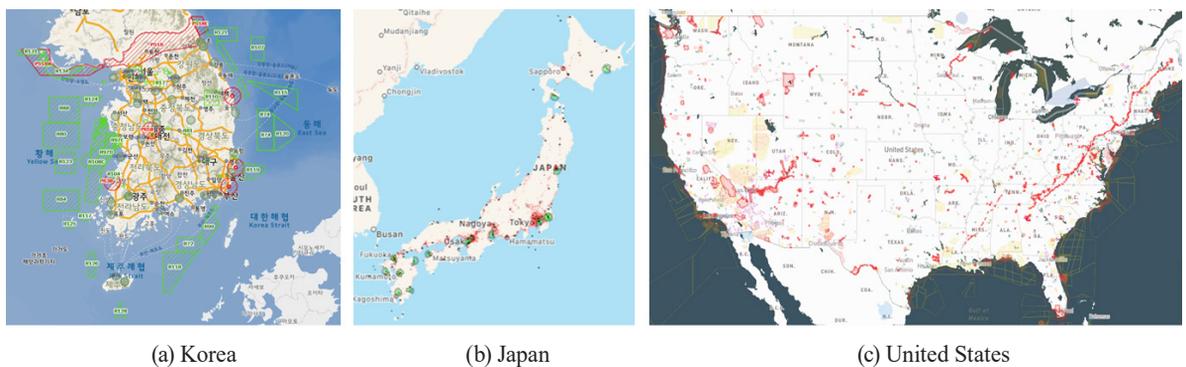


Fig. 2. Restricted areas and no-fly zone for drones

2-2. Deregulation Direction for Drone Operation

As shown in Figure 2, the United States and Japan restricted the flight of drones around airports and important facilities. However, in the case of Korea, there were many areas where drone flight was restricted, including military operation zones as well as major facilities.

GIS (Geographic Information System) data on drone flight restriction zones in Korea was produced, and drone flight restriction zones were calculated using open-API of the spatial information open platform to analyze drone flight restricted zones. The area of the no-fly zone, restricted flight area, and control area calculated using the converted shape files are 21,181.6km², 55,239.1km², 8,418.9km², respectively, and the total is 84,839.67km². Fig. 3 shows the drone flight restricted area in Korea converted into shape file.

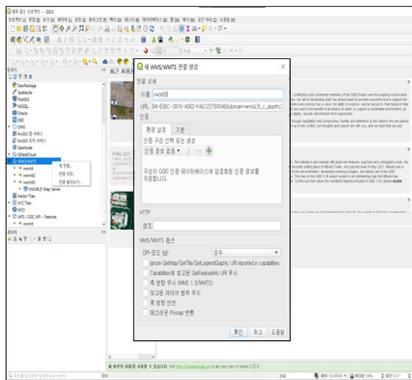
No-fly zone is an area where flying is prohibited by the

Aviation Act and flight restricted area refers to an area where the flight of aircraft not authorized for flight is restricted. And the control area refers to within a radius of 9 km around the airport. These area in Korea is about 84,839.67km². Its area is more than 19.4% of the territory(100,210km²) and territorial waters(337,800km²). It is thought that the field of application of spatial information construction using drones will increase further in the future, and in order to establish a smooth drone spatial information construction, it is necessary to deregulation through review of the flight restricted area.

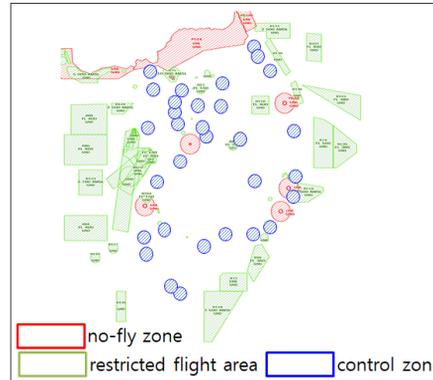
3. Legal System Related to Geospatial Information

3-1. Security of Geospatial Information

In this study, the current status of domestic and foreign legal



(a) GIS software for using open-api



(b) flight restricted area shape file

Fig. 3. Drone flight restricted area in Korea

Table 2. Security level of geospatial information in Korea

Level	classification criteria
Private	<ul style="list-style-type: none"> National security facilities and military facilities where public access is controlled
Restricted to Public	<ul style="list-style-type: none"> Photographs that show traces of deletion of national security facilities and military facilities where public access is controlled More precise data with a resolution of 30m with two-dimensional coordinates Data more precise than 90m resolution with 3D coordinates
Public	<ul style="list-style-type: none"> Aerial photos that are not subject to "private" and "restricted disclosure" Aerial photos with a resolution of more than 25cm are provided or sold only when the owner of the building/land and the head of a management agency or management agency approves it, and personal information and photo contents must be recorded However, in case of providing or selling aerial photos with a resolution of 25cm or more to the general public during the event period, the records may be omitted for international event areas such as the Olympics

Table 3. Survey results of geospatial information security-related regulations

Country	Description
Korea	<ul style="list-style-type: none"> • Cannot provide more precise data than 25cm • Cannot provide National security facilities and military facilities data
United States	<ul style="list-style-type: none"> • Implementation of non-compulsory image erasure of national security facilities
Germany	<ul style="list-style-type: none"> • The main purpose is to protect personal information.
Japan	<ul style="list-style-type: none"> • The main purpose is to protect personal information.

systems related to geospatial data security was investigated to suggest deregulation direction to improve the utility of drone geospatial data. Among the legal systems related to spatial information, the regulations on aerial photograph related to data acquired through drones were investigated.

In Korea, detailed classification criteria for aerial photos are established in the 'National Spatial Information Security Management Regulations'. There are three levels, and they are divided into "Private", "Restricted to Public" and "Public". Table 2 shows the security level of geospatial information in Korea(Korean Law Information Center, 2022).

In the case of the United States, security facilities such as the White House in aerial photography process themselves, but the list of regions that impose restrictions on the disclosure of images and related regulations on the processing of images are not clear. U.S. geospatial information security related regulations are 'Land Remote Sensing Policy Act 1992', 'National Space Policy', 'U.S. There is a 'Commercial Remote Sensing Policy'(Federal Geographic Data Committee, 2022). The UK has no restrictions on the provision of aerial photos, and Germany has a provision prohibiting aerial photography of facilities related to national safety. In Japan, GSI (GeoSpatial Information Authority of Japan) has regulations on the protection of personal information for aerial photos, but there are no other regulations on spatial information(Geospatial Information Authority of Japan, 2022).

3–2. Deregulation Direction for Legal System

Korea is the only country that has formal and specific regulations on spatial information security management, and other countries mainly have regulations on the protection of personal information. Table 3 shows the survey results of geospatial information security-related regulations in Korea,

the United States, the United Kingdom, Germany, and Japan.

Because of the situation with North Korea, South Korea has many restrictions on spatial information. However, there are restrictions on commercial use due to the high level of regulation on the use of drones. Improving the use of drones in the field of spatial information can contribute to the development of the drone industry. In particular, aerial photography using drones has a very high GSD (Ground Sample Distance) of several centimeters, so it will be possible to use it in various fields. It is necessary to revise the NGII (National Geographic Information Institute)'s National Geospatial Information Security Management Regulations. Considering that the GSD of drone images is several centimeters among the security ratings for aerial photography, it is necessary to allow the release of images with a higher resolution than the current 25cm limit. However, in order to improve the legal system, it is necessary to analyze potential risk factors and to revise the legal system in consideration of the relationship with other regulations. Table 4 shows the application fields for each GSD of the aerial image(National Geographic Information Institute, 2022; Lee *et al.*, 2020).

Table 4. Application fields for each resolution of the aerial image

Application field	Ground Sample Distance
Land change detection	12cm or less
3D modeling for digital twin	5cm or less
Slope analysis	5cm or less
BIM application	5cm or less

4. Conclusion

In this study, legal and institutional aspects related to

drone operation and geospatial information were investigated to suggest the direction of increase in drone use in the spatial information field. Korea has set the largest area in areas where drone operation is restricted to build geospatial information. Through GIS analysis, it was suggested that Korea's drone flight restriction zone is more than 19.4% territory and territorial waters. In addition, in order to suggest the direction of improving the legal system related to geospatial information, regulations related to spatial information security in Korea, the United States, the United Kingdom, Germany, and Japan were investigated. As a result of the survey, it was found that Korea is the only country with official and specific regulations on geospatial information security management. In order to increase the use of spatial information using drones, it is necessary to deregulate the restrictions on flight restrictions and security. However, in order to improve the legal system, it is necessary to revise the legal system considering the analysis of potential risk factors and the relationship with other regulations.

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References

- Cho, J.Y., Song, J.I., and Jang, M.Y. (2020), A Study on the Utilization Plan of Drone Videos for Disaster Management, *Journal of the Korea Academia-Industrial cooperation Society*, Vol. 21, No. 10, pp. 372-378. (in Korean with English abstract)
<https://doi.org/10.5762/KAIS.2020.21.10.372>
- Federal Aviation Administration (2022), News, small-unmanned-aircraft-system, *Federal Aviation Administration's Homepage*, <https://www.faa.gov/> (last date accessed: 31 July 2022)
- Federal Geographic Data Committee (2022), Policy and planning, Guidelines, *Federal Geographic Data Committee's Homepage*, <https://www.fgdc.gov/> (last date accessed: 31 July 2022)
- Geospatial Information Authority of Japan (2022), Chubu District Survey Department, Chubu District Survey Department Mail News, *Geospatial Information Authority of Japan's Homepage*, <https://www.gsi.go.jp/> (last date accessed: 31 July 2022)
- Han, D.Y. (2021), Building Modeling Using Drone Thermal Images, *Journal of The Korean Cadastre Information Association*, Vol. 23, No. 3, pp. 3-10. (in Korean with English abstract)
<https://doi.org/10.46416/JKCIA.2021.12.23.3.3>
- Kim, D.P., Back, K.S., and Kim, S.B. (2021), Production and Accuracy Analysis of Topographic Status Map Using Drone Images, *Journal of the Korean Geo-Environmental Society*, Vol. 22, No. 2, pp. 35-39. (in Korean with English abstract)
<https://doi.org/10.14481/jkges.2021.22.2.35>
- Kim, G.W. (2021), A Study on Drone Location Tracking for 3D Precision Map Production for Realistic Media, *Journal of Knowledge Information Technology and Systems*, Vol. 16, No. 5, pp. 1013-1021. (in Korean with English abstract)
<https://doi.org/10.34163/jkits.2021.16.5.012>
- Kim, D.P. and Lee, J.W. (2021), Positional Accuracy Analysis According to the Exterior Orientation Parameters of a Low-Cost Drone, *KSCE Journal of Civil and Environmental Engineering Research*, Vol. 42, No. 2, pp. 291-298. (in Korean with English abstract)
<https://doi.org/10.12652/Ksce.2022.42.2.0291>
- Korean Law Information Center (2022), Law Search, National Spatial Information Security Management Regulations, *Korean Law Information Center's Homepage*, <https://www.law.go.kr/> (last date accessed: 31 July 2022)
- Lee, J.S. (2021), Efficient 3D Modeling Automation Technique for Underground Facilities Using 3D Spatial Data, *Journal of the Korea Institute of Information and Communication Engineering*, Vol. 25, No. 11, pp. 1670-1675. (in Korean with English abstract)
<https://doi.org/10.6109/jkiice.2021.25.11.1670>
- Lee, J.W., Kim, D.P., and Sung, S.M. (2020), Assessment of LODs and Positional Accuracy for 3D Model based on UAV Images, *Journal of the Korea Academia-Industrial*

- cooperation Society*, Vol. 21, No. 10, pp. 197-205. (in Korean with English abstract)
<https://doi.org/10.5762/KAIS.2020.21.10.197>
- Ministry of Government Legislation (2022), The Korean Law Information Center, Aviation Safety Act, *Korean Law Information Center's Homepage*, <https://www.law.go.kr/> (last date accessed: 15 August 2022)
- Ministry of Land, Infrastructure and Transport (2022), Policy Issues, National Geographic Information System, *Ministry of Land, Infrastructure and Transport's Homepage*, <http://www.molit.go.kr/> (last date accessed: 31 July 2022)
- Ministry of Land, Infrastructure, Transport and Tourism (2022), Statistics, Guide book, Ministry of Land, Infrastructure, *Transport and Tourism's Homepage*, <https://www.mlit.go.jp/> (last date accessed: 31 July 2022)
- National Geographic Information Institute (2022), Key Activities, *NGII's home page*, <https://www.ngii.go.kr/> (last date accessed: 15 August 2022)
- Park, J.K. and Lee, K.W. (2020), Comparison of Characteristics of Drone LiDAR for Construction of Geospatial Information in Large-scale Development Project Area, *Journal of the Korea Academia-Industrial cooperation Society*, Vol. 21, No. 1, pp. 768-773. (in Korean with English abstract)
<https://doi.org/10.5762/KAIS.2020.21.1.768>
- Park, J.K. and Lee, K.W. (2022), Geospatial Information Quality and Accuracy Analysis of Drone LiDAR according to Flight Plan, *Journal of the Korea Academia-Industrial cooperation Society*, Vol. 23, No. 3, pp. 205-210. (in Korean with English abstract)
<https://doi.org/10.5762/KAIS.2022.23.3.205>
- Seoul Regional Office of Aviation (2022), Information, Aerial photography guide, *Homepage of Drone One-stop Service*, <https://drone.onestop.go.kr/> (last date accessed: 15 August 2022)
- U.S. Department of Transportation, Newsroom (2022), UAV Geography, *Department of Transportation's Homepage*, <https://www.transportation.gov/> (last date accessed: 31 July 2022)