Drones / UAV (Airborne Observation)

Source: istock/AndreyPopov

Construction site supervising engineer watching live drone video on his tablet

Relevance of this Tool Type within the Project Cycle

Drones can be helpful in providing aerial imagery for monitoring agriculture, wildlife, the environment, and infrastructure (e.g., bridges, buildings, and roads).

Definition

A drone (also: Unmanned Aerial Vehicle; UAV) is an aircraft without a human pilot aboard. Drones can be equipped with sensors and cameras to analyze and monitor specific project locations (including, infrared, night vision, 3D-cameras, and video recording).

Step 1: Is It Allowed?

The operation of drones is subject to national laws and regulations > RMMV Guidebook Section 2.3 *Legal Aspects* for further details.

Step 2: What Information Do I Need?

Drones are collecting data to make accurate, two-dimensional maps, elevation models, and 3D models of terrain. Mapping is the most common and most popular drone application to date:

- Capturing aerial imagery and making base maps of small areas (<15 km²)
- Collecting optical imagery where cloud cover precludes the use of satellites and airplanes
- Operating in dense and fast-changing environments, such as urban areas and refugee camps
- Creating accurate elevation models needed for flood, avalanche, and debris flow modelling and rubble volume calculations
- Making 3D renderings of buildings and geographic features

Step 3: What to Consider When Acquiring Them

✓ Does a project stakeholder already use drones? Can they be employed for the project?

✓ If not, is a purchase of equipment (drones, cameras, sensors) needed or are full-service providers available? Operating drones and processing aquired data requires trained personnel see Drone Procurement Guide > Links to Further Sources.

✓ How do I obtain the permit from the local authorities?

✓ If the target area is populated, how do I prepare the local population for the deployment of drones?

✓ Are additional preparation steps needed, for example flight plans, detailed piloting instructions, and equipment operations?

✓ How will the collected data be extracted and processed, for example feature mapping, rendering of 2D images, or 3D models?

✓ Are specialists/experts needed to analyze the data?

Types of Drones

A wide variety of drones are already being used for mapping and monitoring purposes:

- **Fixed-wing drones** (like a plane) are used for long distance operations (larger mapping projects or surveillance) and typically stay in the air for several hours. Drawback: they require open space for landing and take-off.
- **Multi-rotor drones** (like a helicopter) are used for aerial photography or aerial video surveillance in short distances. Drawback: at present, most of the multi-rotor drones are capable of only 20 to 30 minutes of flying time (often with a minimal payload like a camera).
- **Single-rotor drones** (like a helicopter) are more efficient than multi-rotor versions. They have higher flying times and can even be powered by gas engines. They can be used for aerial laser scanning (LiDAR). Drawback: higher costs, complexity, and danger.
- **Hybrid drones** combine advantages of fixed-wing and multi-rotor drones but are highly complex to operate.
- **Kite drones** are used for aerial photography in low-resource environments.

Most drones are flown by human pilots stationed on the ground and within sight of the drone (up to 1 km in clear skies).

Types of Sensors

Optical instruments, or sensors, can be mounted on drones for monitoring and surveying purposes:

- **Cameras** are used for aerial photography and video recordings. Photos captured with drones can be used for generating digital elevation models of small areas (~ 5 ha).
- **LiDAR** (Light Detection and Ranging) sensors, which measure the reflection time of a pulsed laser beam, have a variety of uses, for example to generate accurate digital elevation models of bigger areas or in agriculture and forestry to analyze plant structures by height, density, or heterogeneity.
- **Electro-Optical Systems** (EOS) operate in visible and infrared spectral ranges and may be used for thermal imaging, for example building inspection or night vision. EOS equipped with multi- or hyper-spectral cameras provide additional data on features, for example the health of crops.

Risks and Alternatives

- **Danger of misuse** of drones for criminal and terrorist purposes, such as spying, smuggling, and (terrorist) attacks on people, vehicles, or buildings (combat drones).
- **Airplanes and helicopters** can also be used for airborne observations. They can capture very high-resolution imagery and highly accurate digital elevation models of large areas. Drawback: only a few providers are available, authorization is difficult, and costs are high.

The RMMV Guidebook provides further details regarding the pros and cons of different airborne and space observation techniques. > RMMV Guidebook Section 2.5. Decision Matrix

- **Earth observation (EO, satellites)** is another source for aerial imagery and features mapping > Factsheet Earth Observation via Satellites. Compared to airborne observation, EO imagery can cover very large areas and provide retrospective analysis. Content is available from open and commercial sources and does not require additional authorization. Costs are dependent on the spatial and temporal resolution.

Legal Aspects

National Laws are affecting the operation of drones and the enforcement of these laws vary by country. Restriction arise from national drone regulations, emissions regulations, and drone restrictions of certain areas, such as critical infrastructure or at certain times, for example during conflict. The United Nations International Civil Aviation Organization (ICAO) strives to provide a fundamental international regulatory framework through Standards and Recommended Practices > Links to Further Sources.

Human rights: In countries with human rights issues or in conflict settings, drone images can be used against the population or vulnerable parts thereof, such as minorities. Especially in areas where drones are not known or where combat drones have been operating, drones may create fear among the population and, hence, operators are required to inform the population before an operation starts > RMMV Guidebook Section 2.3.3.

Data protection: Drones equipped with cameras have the potential to violate privacy if individual persons are identifiable in the video recordings. Avoid the inadvertent collection of personal data by avoiding filming individuals in ways that could lead to their identification. Only strictly relevant personal data should be collected and processed. If data minimization is not possible, data has to be anonymized (e.g., by blurring or pixilation > RMMV Guidebook Section 2.3.1.

If KfW (or persons acting on behalf of it) are (also) processing personal data, the privacy check in > RMMV Guidebook Section 2.3.1 must be followed.

Liability: If persons are injured or property is damaged during a drone flight, the owner and/or the operator of the drone may be liable regardless of whether he or she is at fault in the specific case (i.e., intent or negligence). For this reason, many countries require third-party insurance even if you are operating a lighter drone (e.g., Article 14 (2) (d) of EU Regulation 2019/947). Local law requirements for insurance of drone operators should be checked.

Project Examples / Use Cases

- In the Biodiversity and Adaption to Climate Change Programme in Mongolia (BioDiv-III; PN: 43760), drones were used by the national park administration to manage the area.
- In an irrigation project in Mali (IRRIGAR-IIIa; PN 39888), drones were used to monitor constructed irrigation systems.
- In the Small-scale irrigation project PNIP in Mali (PNIP; PN: 31800), UAVs were used primarily to monitor project indicators like acreages and environmental protection in terrain difficult to access.

Links to Further Sources

- ICAO guidelines on UAV regulation: https://www.icao.int/safety/ua
- Drones in Humanitarian Action (Guide) https://reliefweb.int/sites/reliefweb.int/files/resources/Drones%20in%20Humanitarian%20Action.pdf
- Potential of Drones (World Bank brief) https://www.worldbank.org/en/topic/transport/brief/drones-for-development
- Drone Procurement Guide https://www.ictworks.org/wp-content/uploads/2018/10/usaid-UAV-buying-guide.pdf
- Code of Conduct for Use of Drones https://docs.google.com/document/d/1Uez75_qmIVMx-Y35OzqMd_HPzSf-Ey43IJ_mye-kEEpQ/edit
- Regulations database https://www.droneregulations.info/

Linkages to other tool types

(Remote) Management Information Systems

Geospatial Tools

Cameras

Earth Observation via Satellites

Further information on how to use this tool type in an RMMV context can be found here: